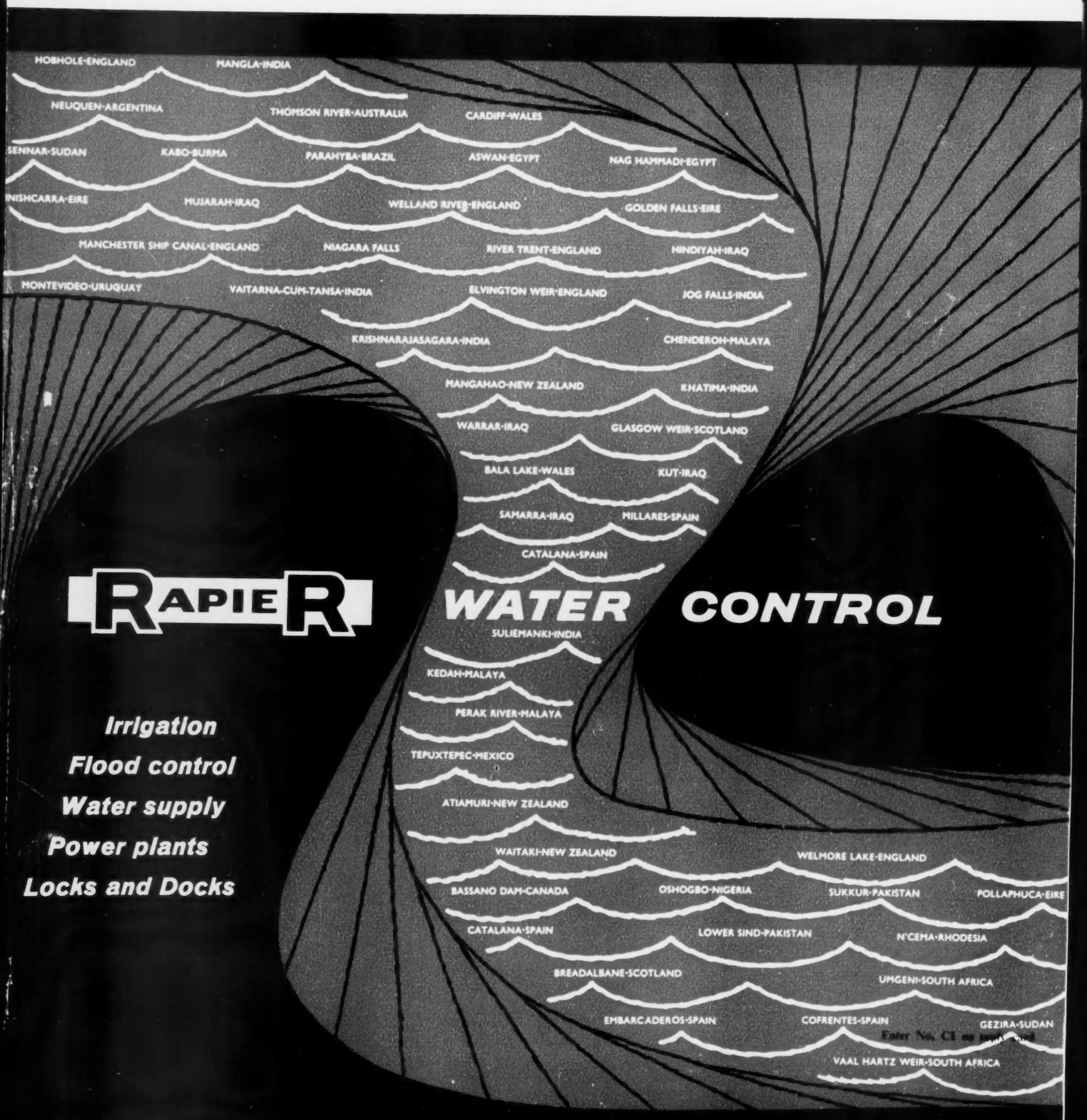
THE ENGINEER

OCTOBER 30, 1959 | 28 ESSEX STREET, STRAND, LONDON, W.C.2 | TWO SHILLINGS



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THE ENGINEER

Established 1856

No. 5414 **OCTOBER 30, 1959** VOL. 208

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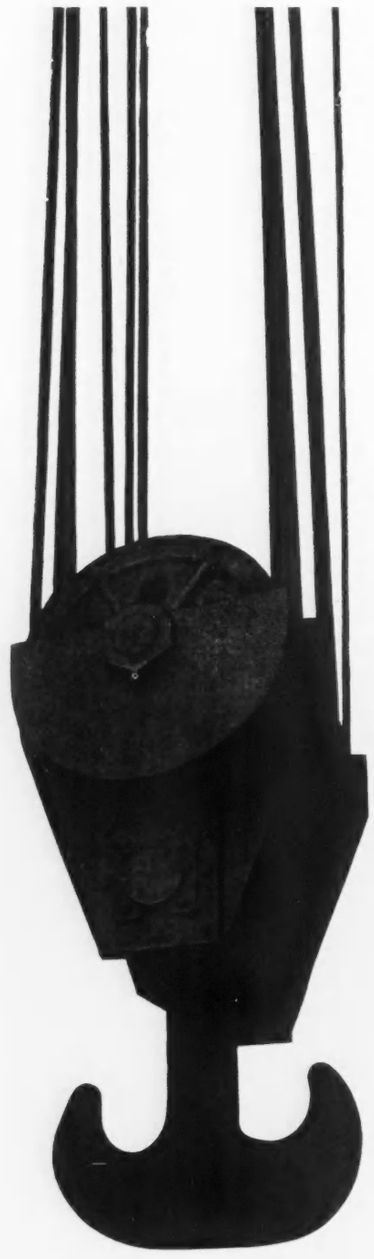

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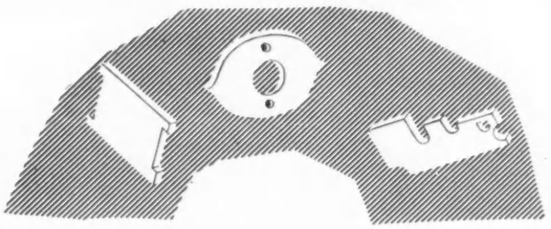

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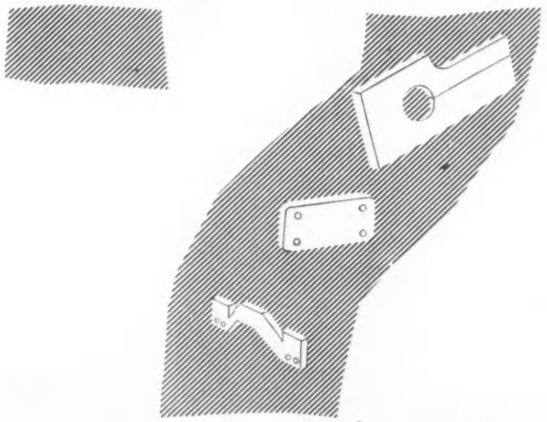

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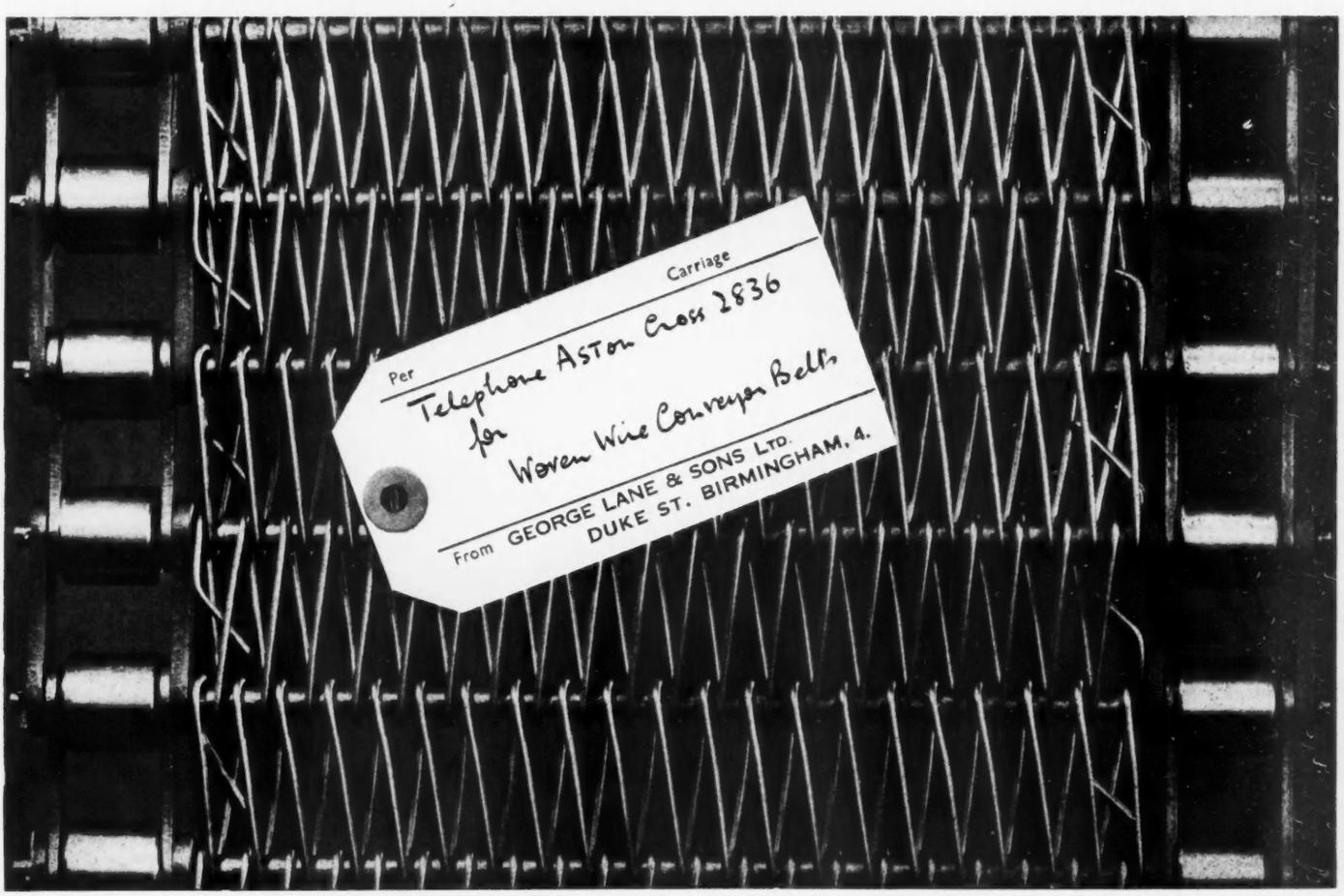

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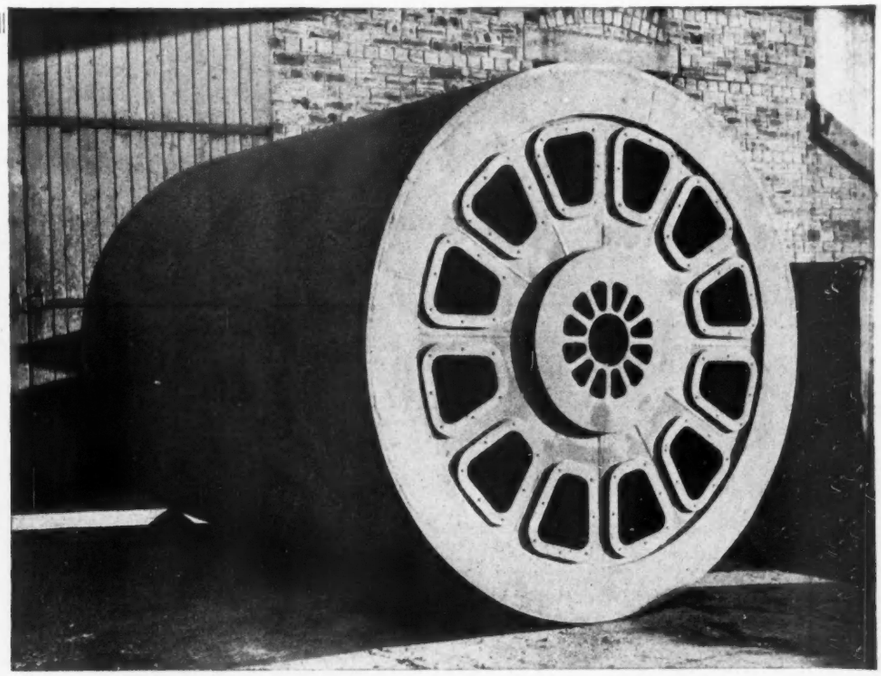

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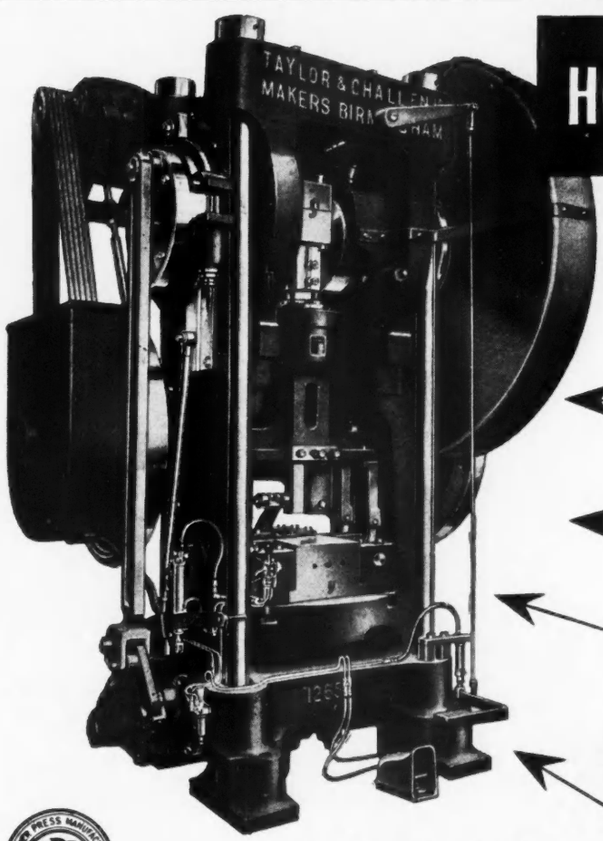

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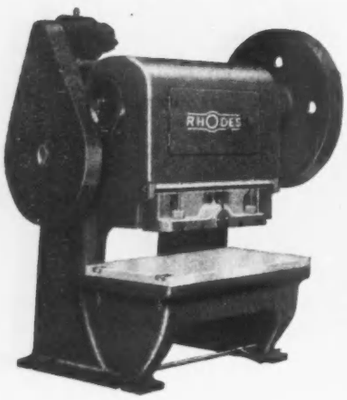

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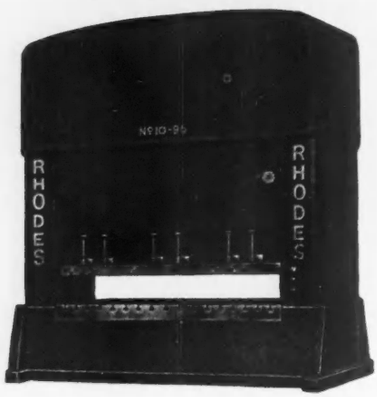

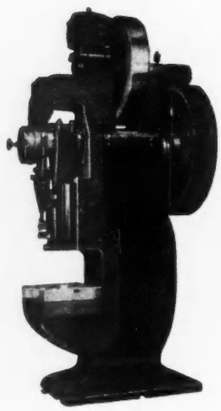

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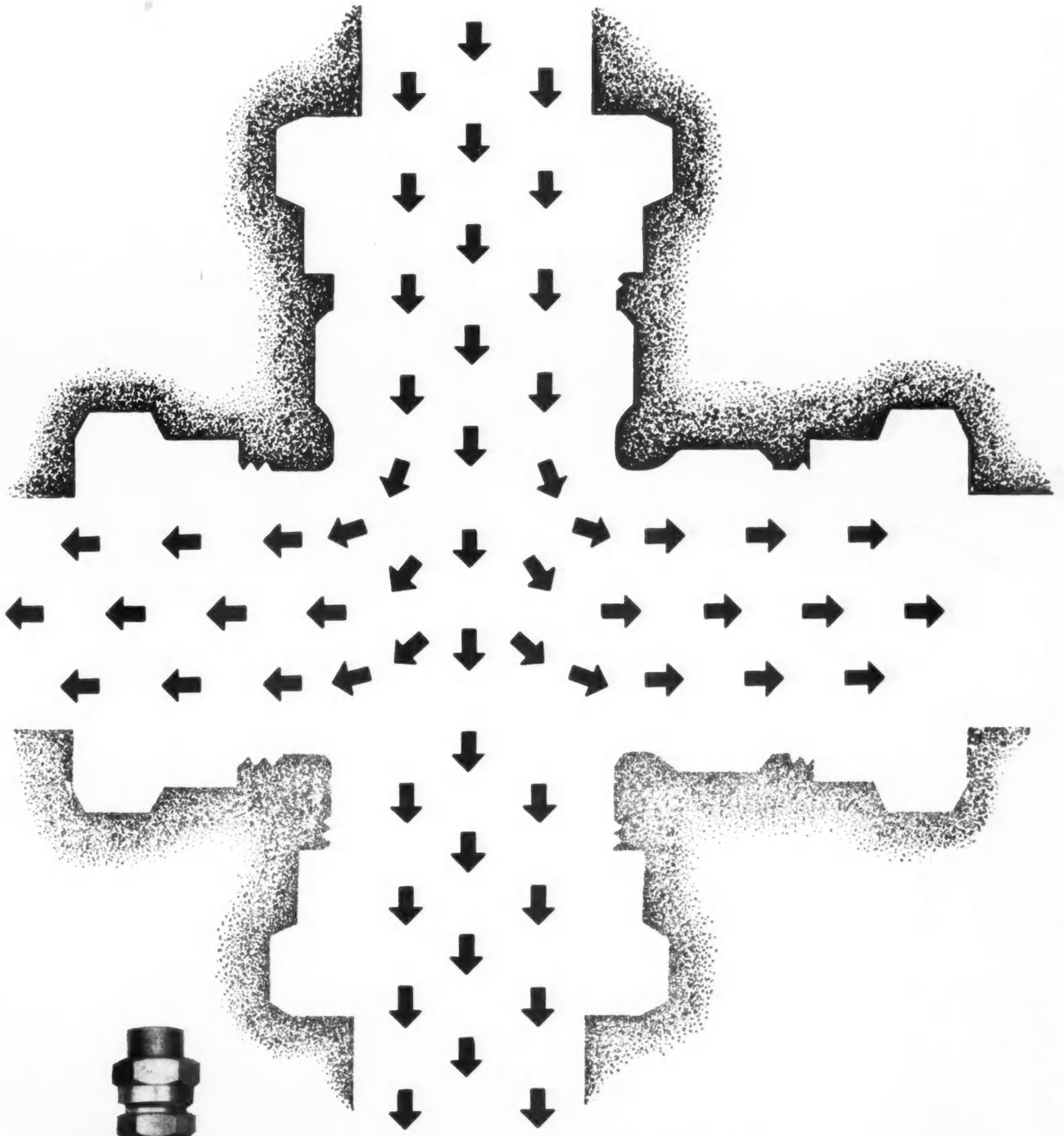

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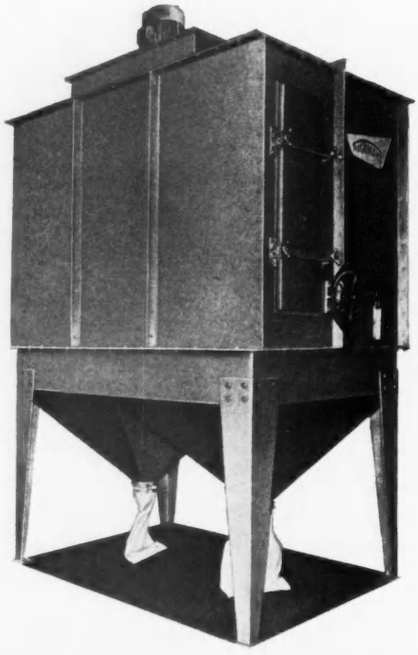
These collectors are built with 50 sq. ft. area and 150 sq. ft. area. The volumes handled are from 250 c.f.m. to 2,100 c.f.m. For further details of these collectors, send for our new leaflet, T.53.

3 NEW DUST COLLECTORS

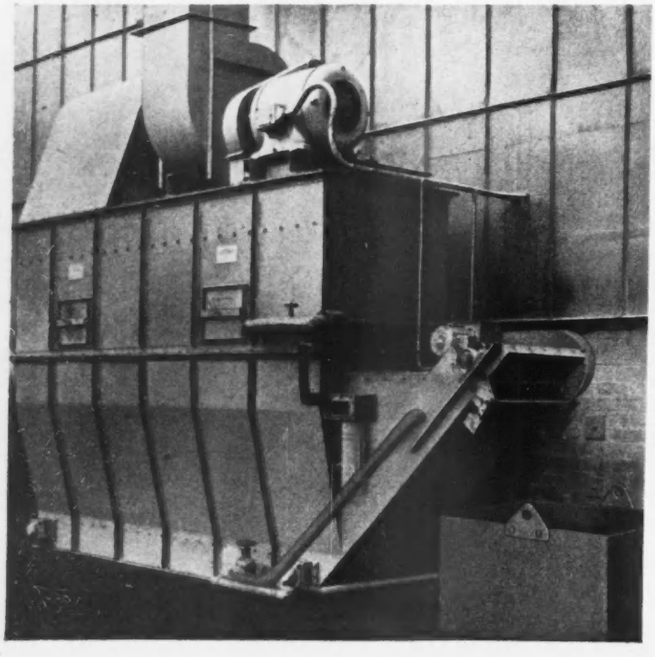
T54 TUBULAR FABRIC DUST COLLECTORS



A range of tubular fabric dust collectors with integral direct driven fan. Where the headroom is limited, dust hoppers or base units can be fitted.

These machines are built in a range of filtering areas from 80 sq. ft. to 720 sq. ft., and standard volumes from 1,000 c.f.m. to 6,000 c.f.m.

These are robustly constructed, high efficiency, dust collectors at low cost. Further details can be obtained by sending for leaflet T.53.



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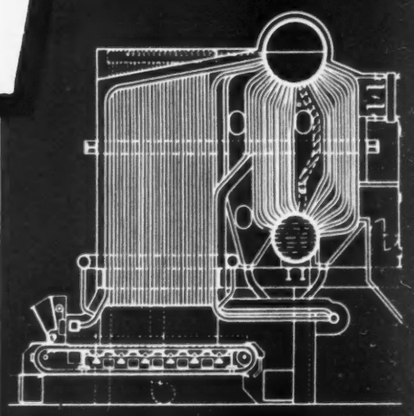

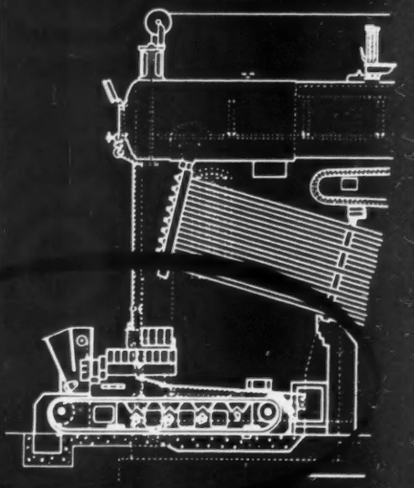

Illustrations: Above, Bi-drum boiler equipped with Renfrew stoker. Right, Renfrew stoker applied to existing, hand-fired water-tube boiler.

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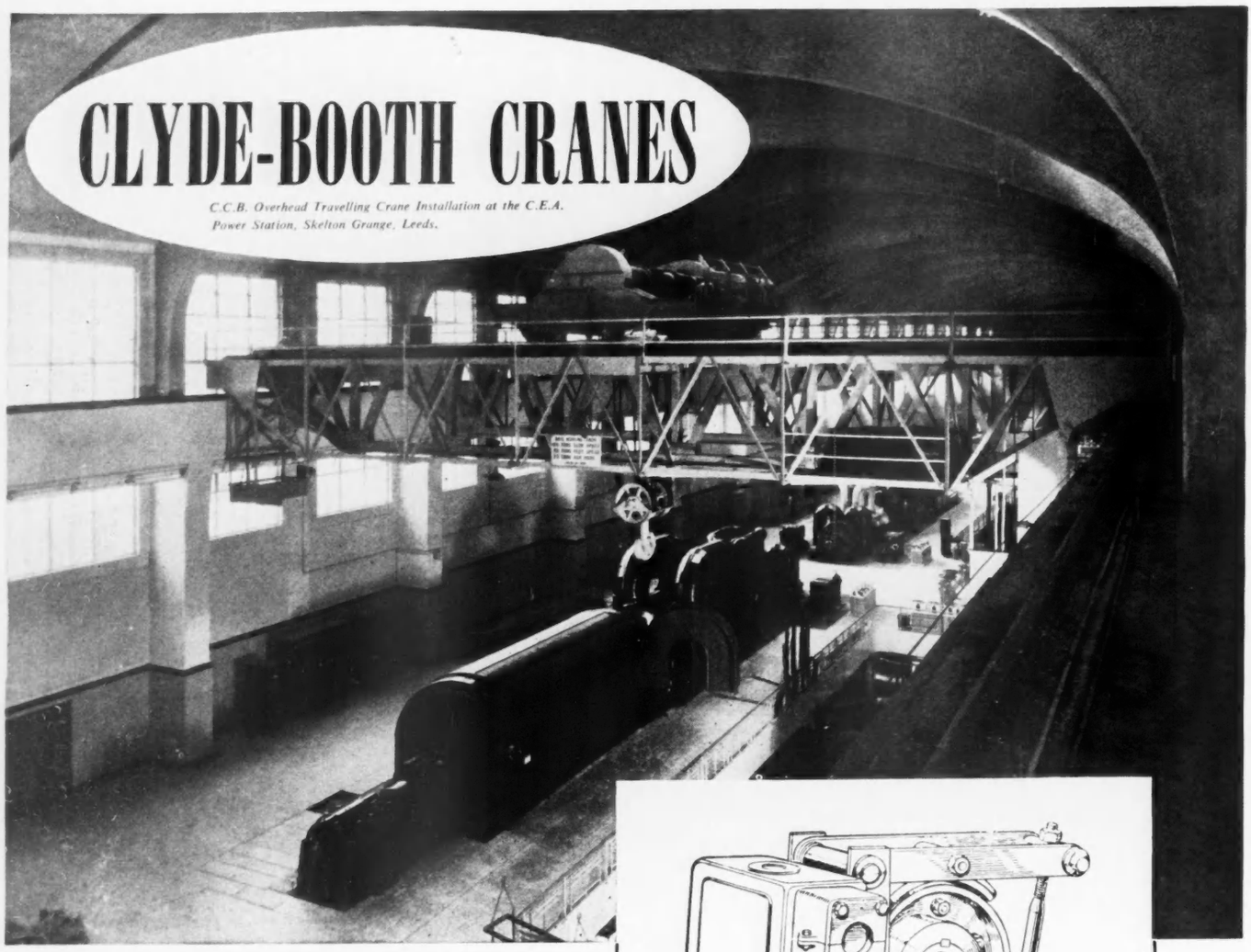

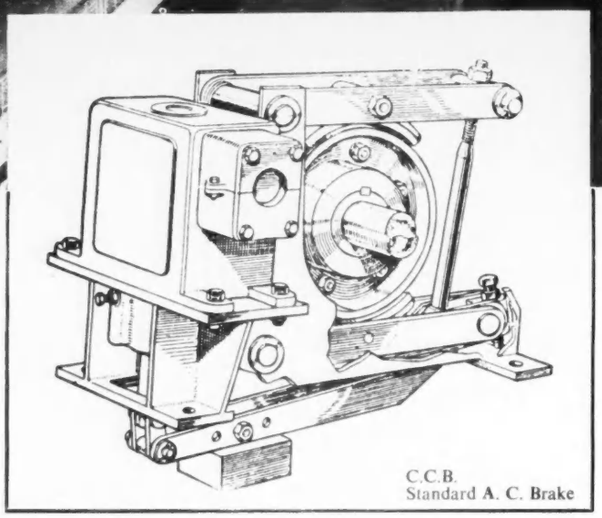

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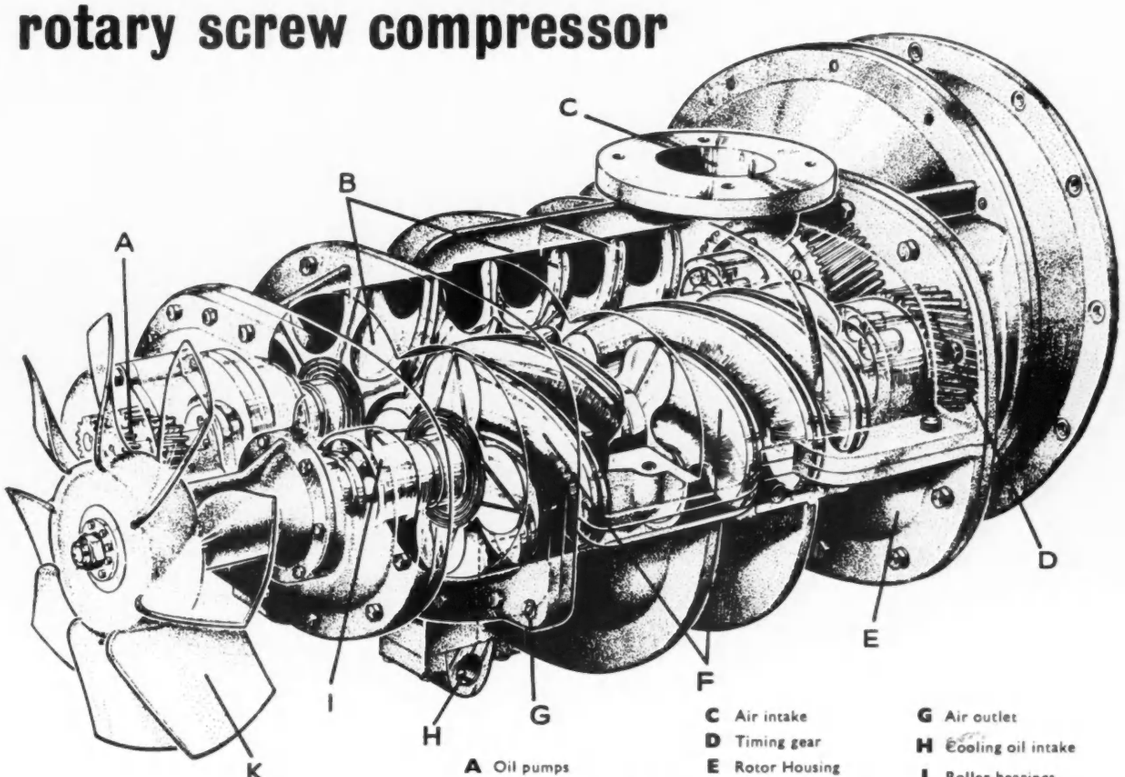

A Oil pumps
B Female rotor, primary and secondary stage
C Air intake
D Timing gear
E Rotor Housing
F Male rotor, primary and secondary stage
G Air outlet
H Cooling oil intake
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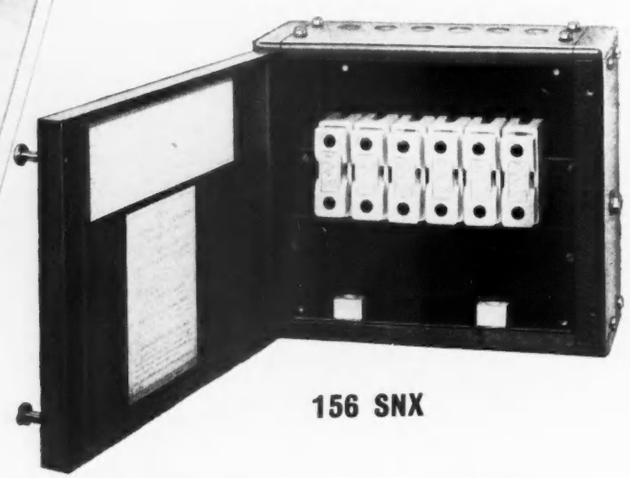

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ENGINEERS OF PROGRESS

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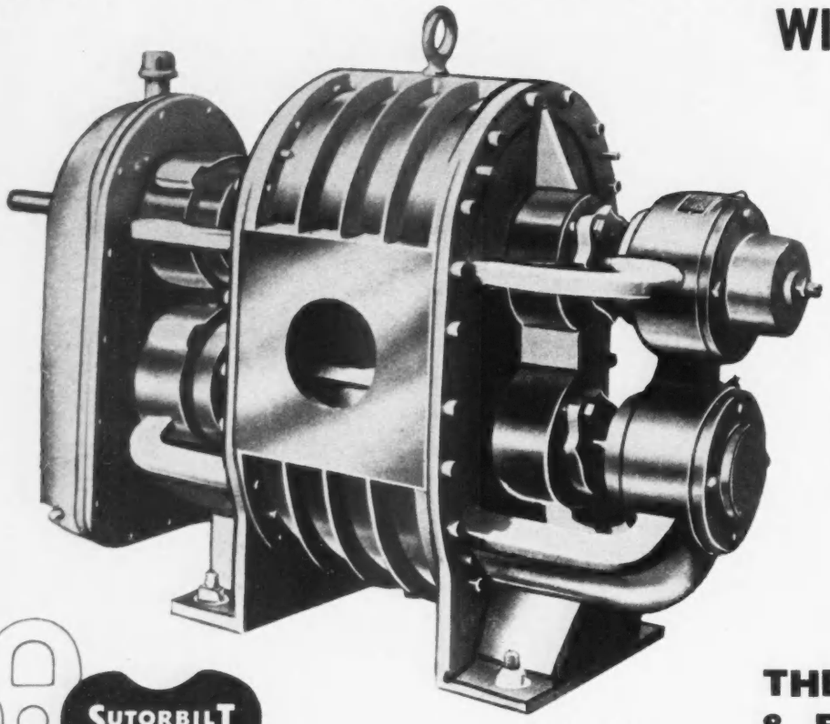
C

NEW "400" SERIES SUTORBILT ROTARY POSITIVE BLOWERS WITH OIL-FREE OPERATION



Because **SUTORBILT** Blowers require no internal lubrication, compressed air or gas is delivered OIL FREE. This is the most important feature in air conveyors handling food and chemicals in particular.

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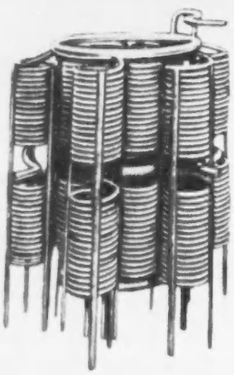

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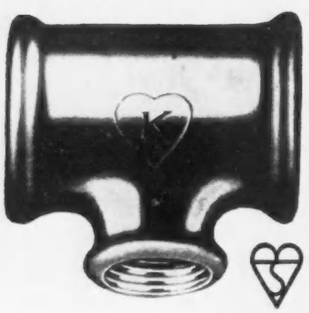

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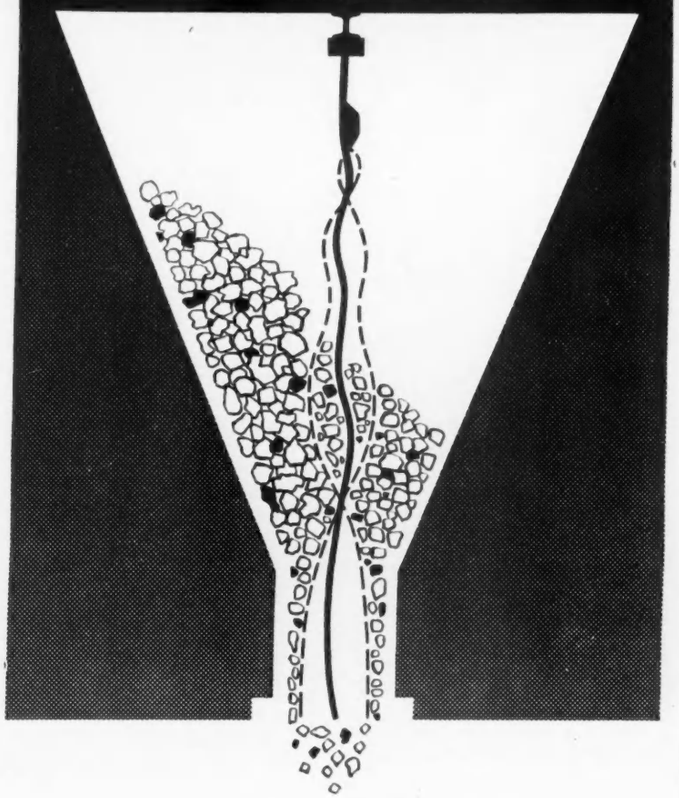

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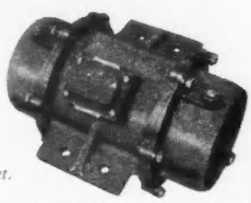

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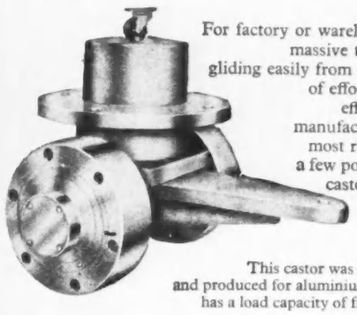

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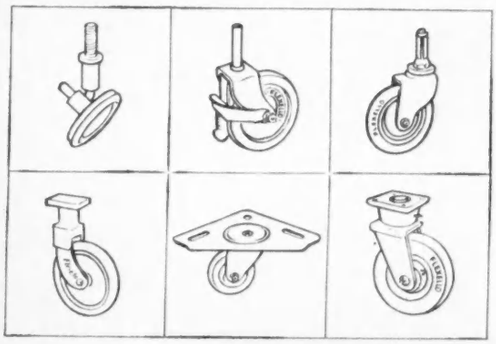

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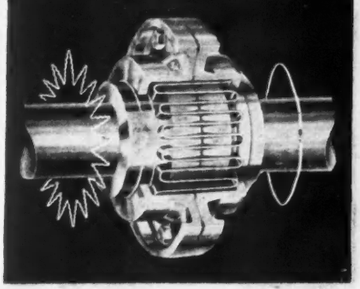

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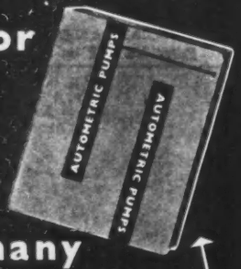

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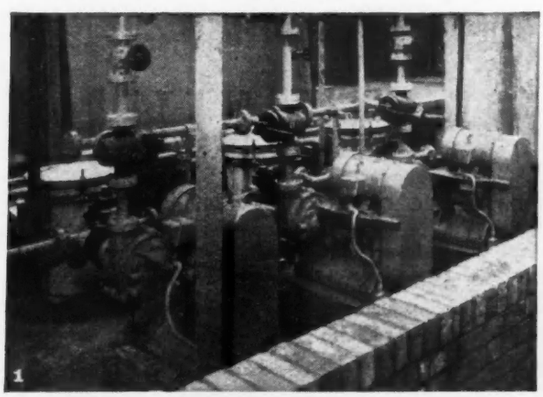

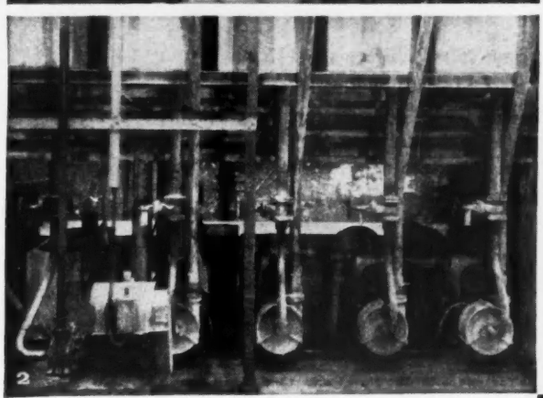

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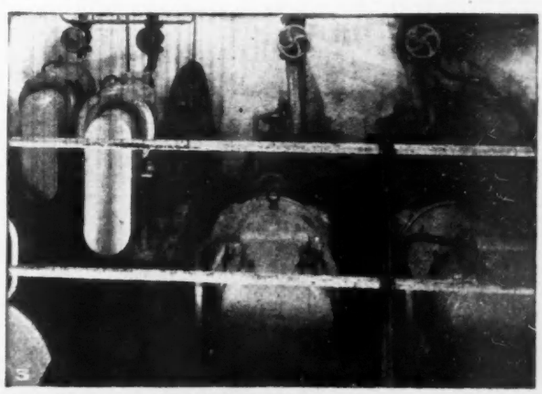

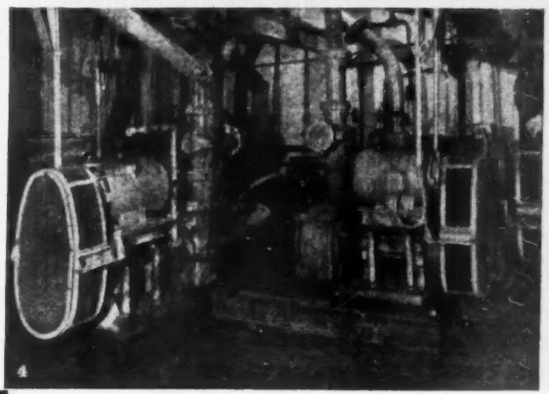

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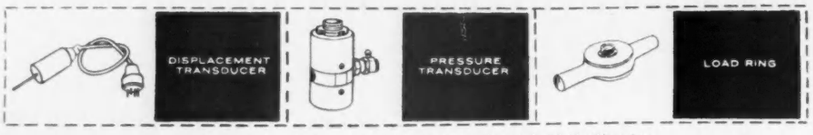

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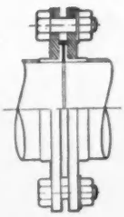

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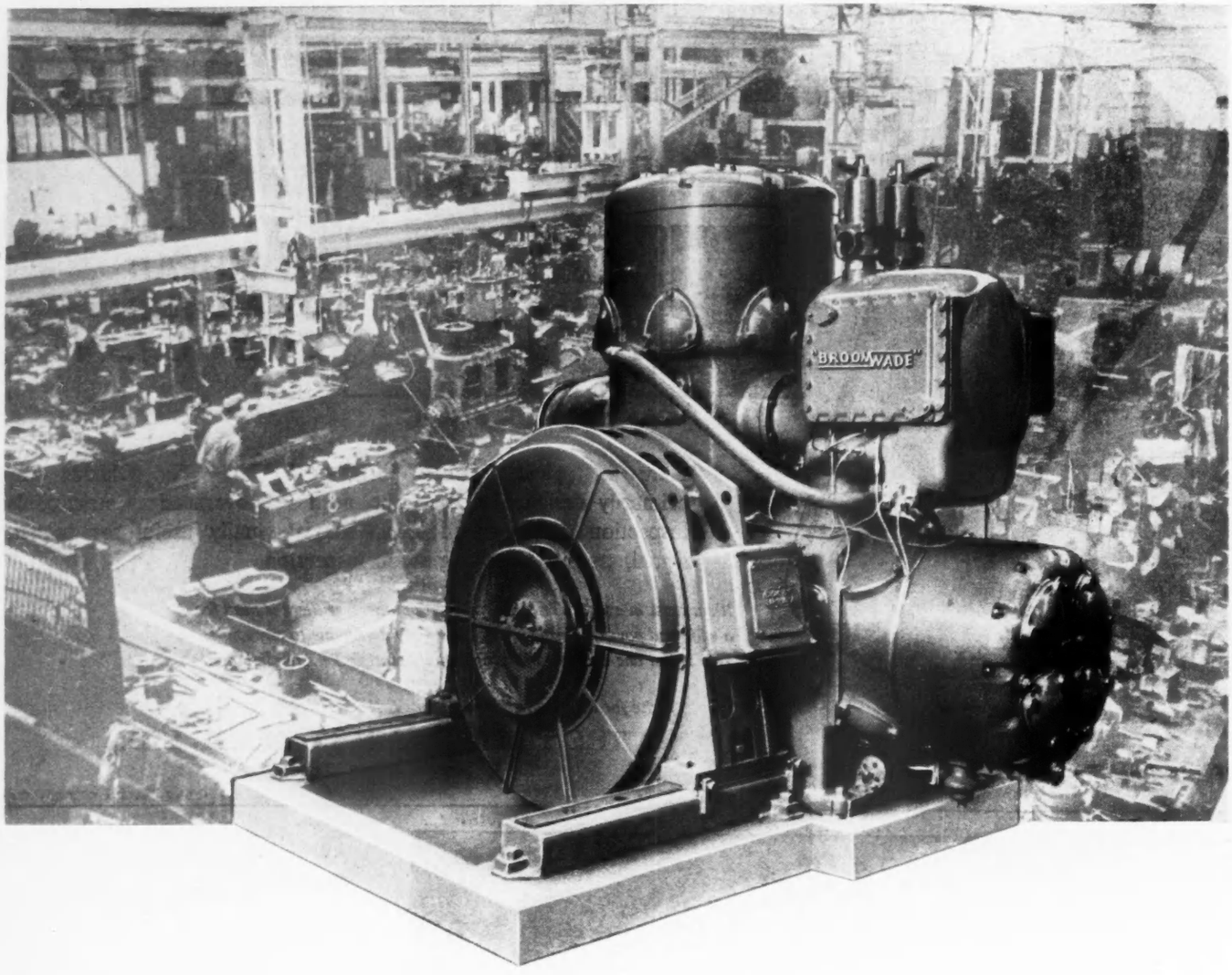

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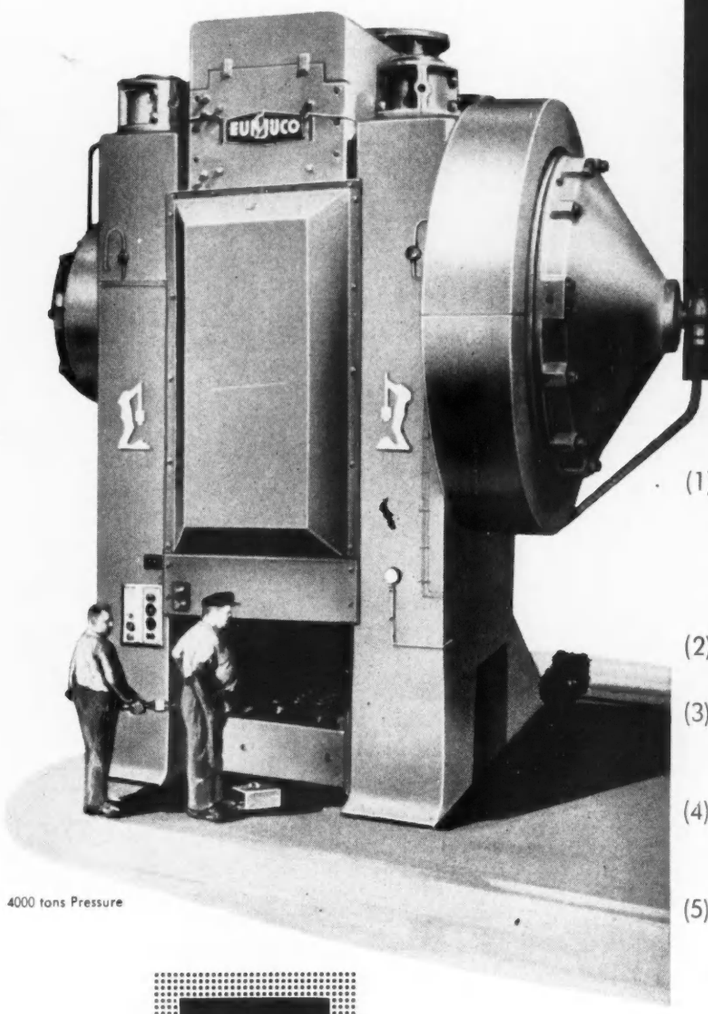

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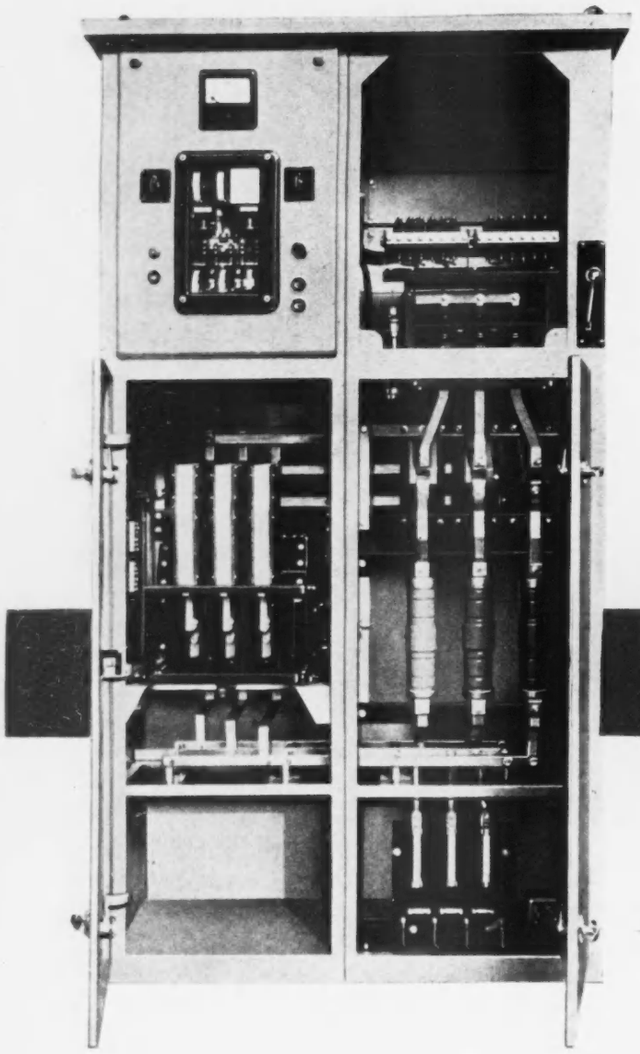

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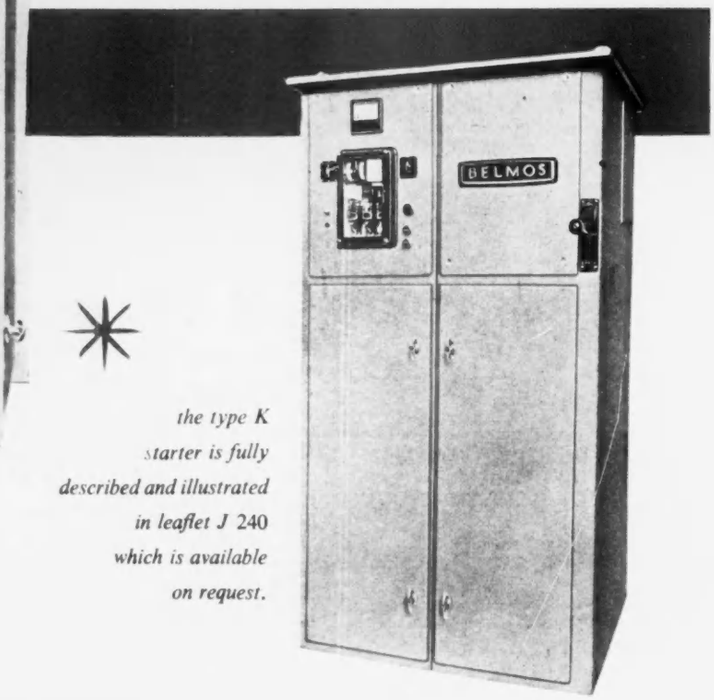

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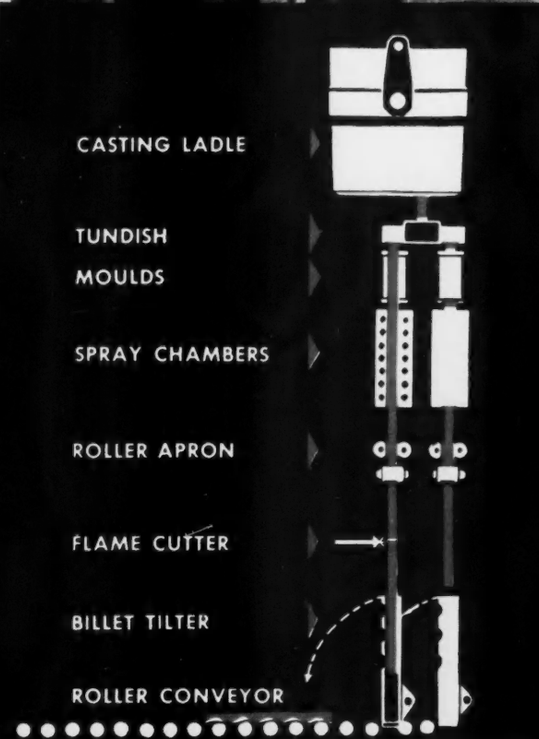

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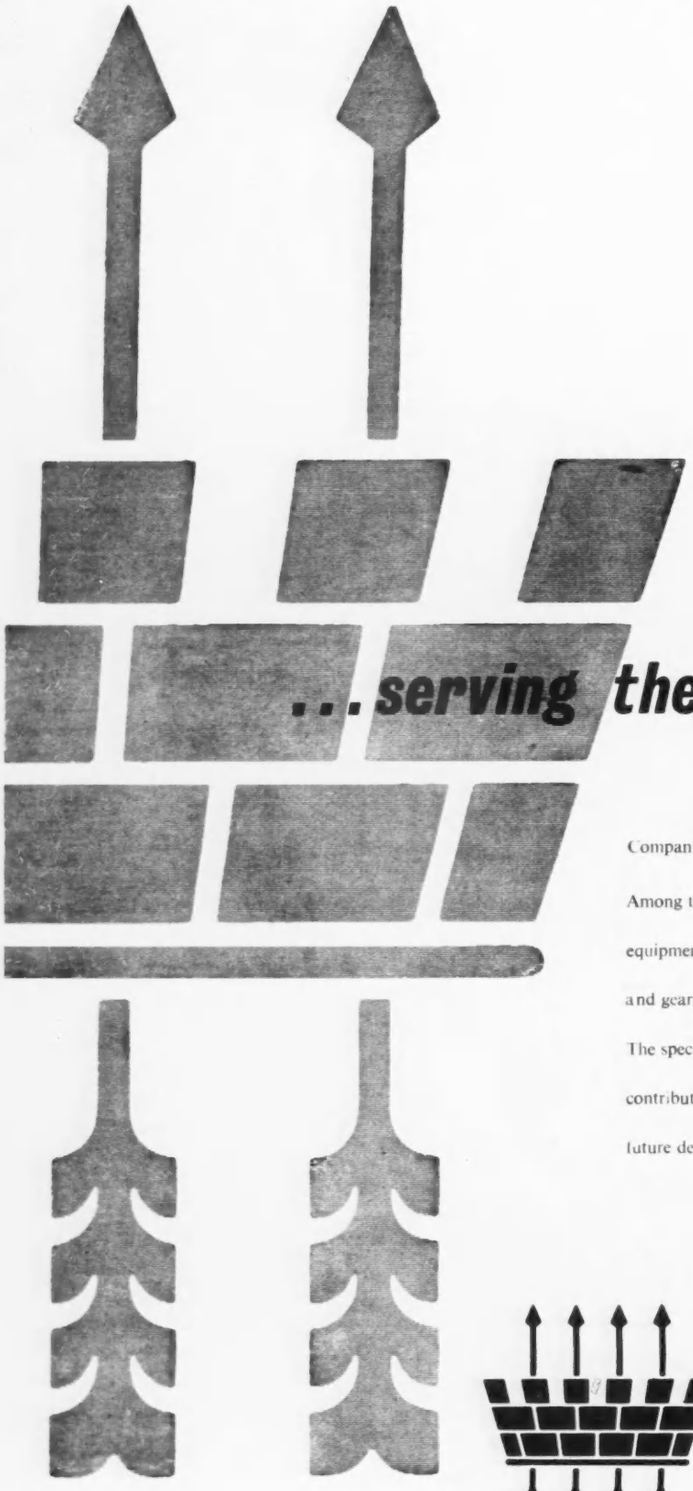

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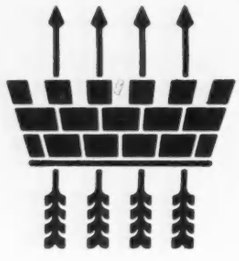

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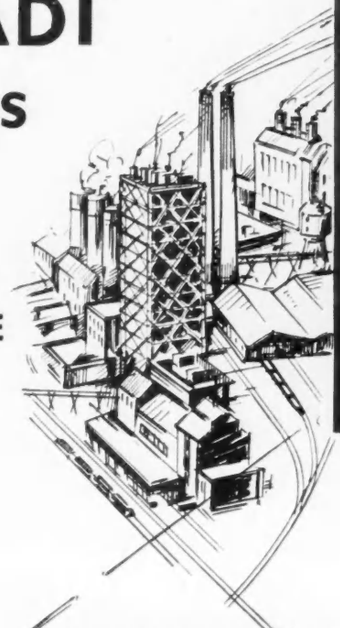

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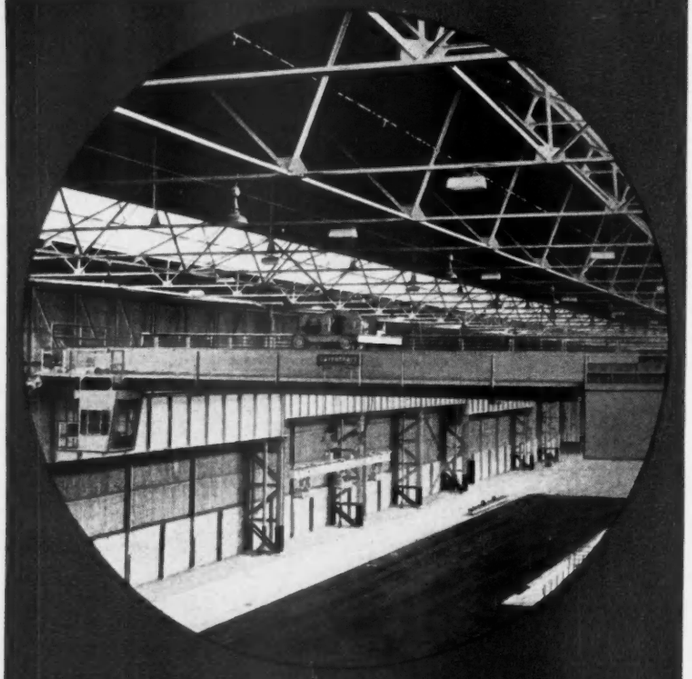

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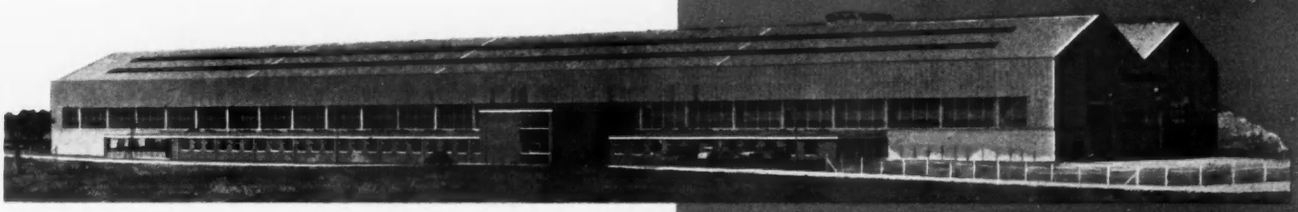

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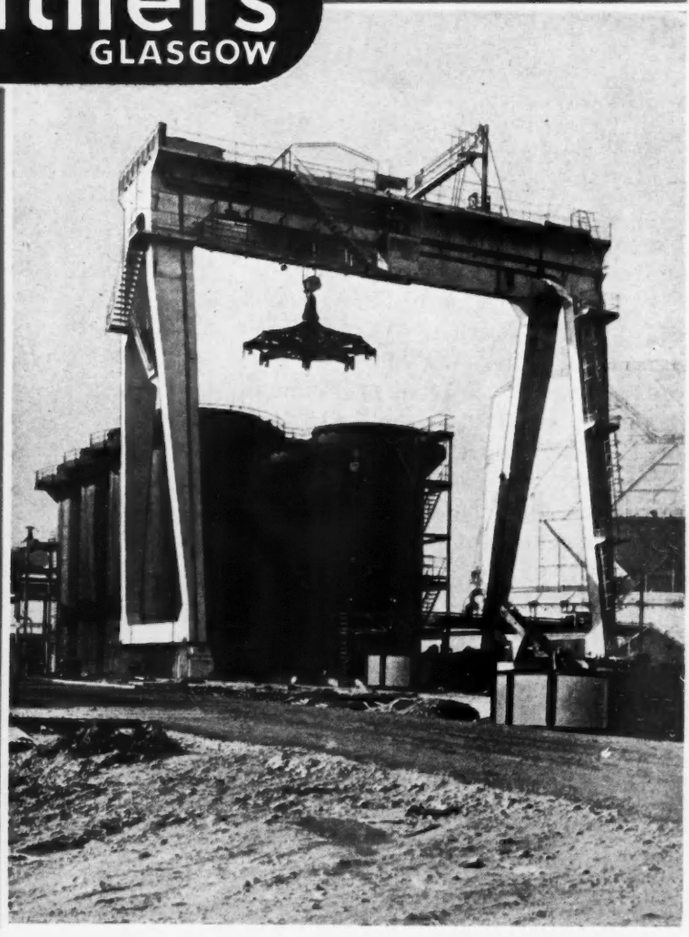

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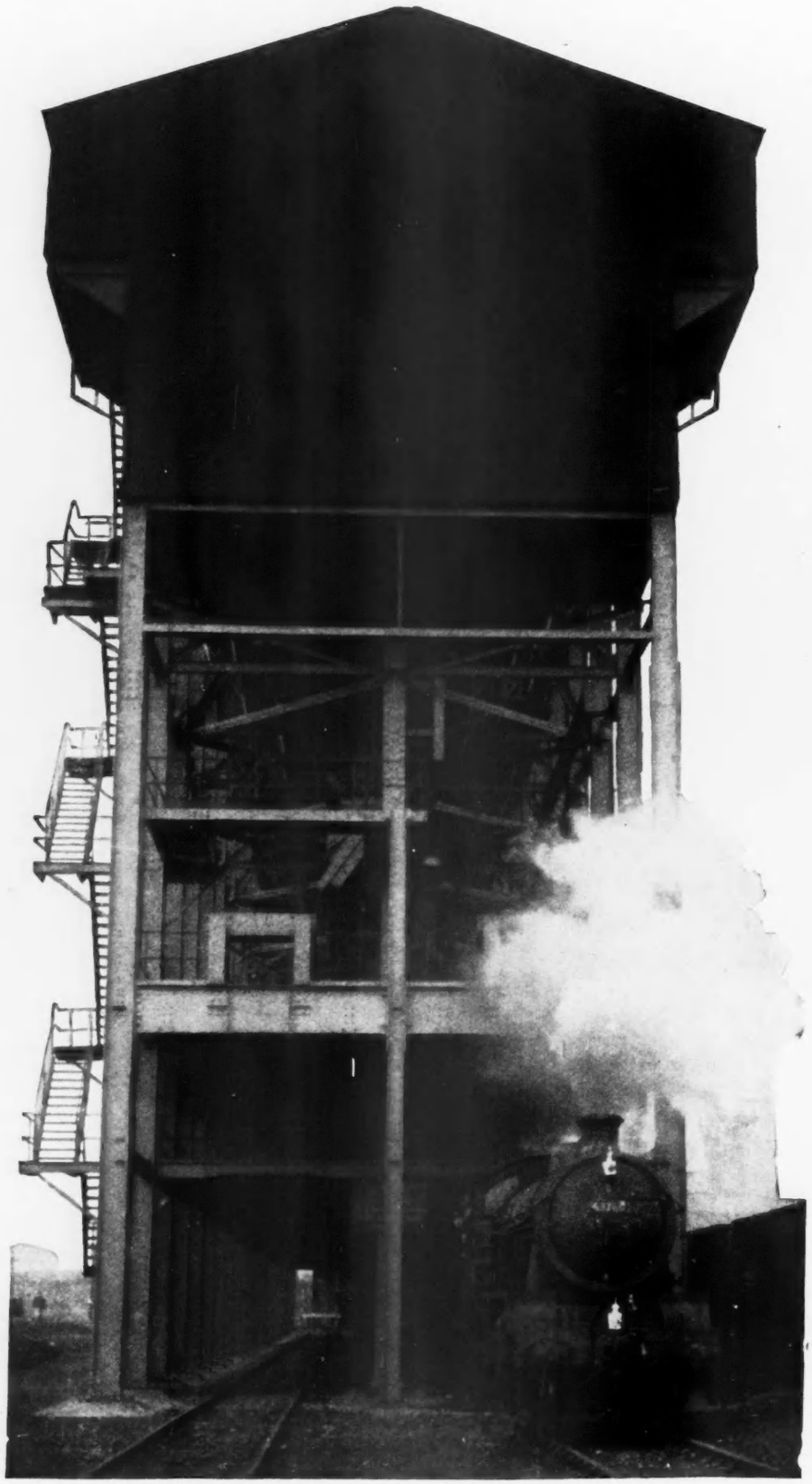
Built to handle

IRON ORE



Another train carrying 500 tons of ore leaves Tyne Dock, South Shields, for the blast furnaces. The ore has been handled in a Simon plant that moves it at a maximum rate of 1500 tons an hour from ship to shore. From Simon storage bunkers with a maximum capacity of 12,700 tons, the ore is weighed out into two lines of loading out hoppers. A train draws under one of the lines and over 500 tons of ore are released in a few seconds to waiting wagons. Every operation is carefully synchronised and controlled. In the three years after its commissioning, this plant handled over three and a half million tons of ore. Plants designed and built by Simon are handling a wide variety of materials all over the world.

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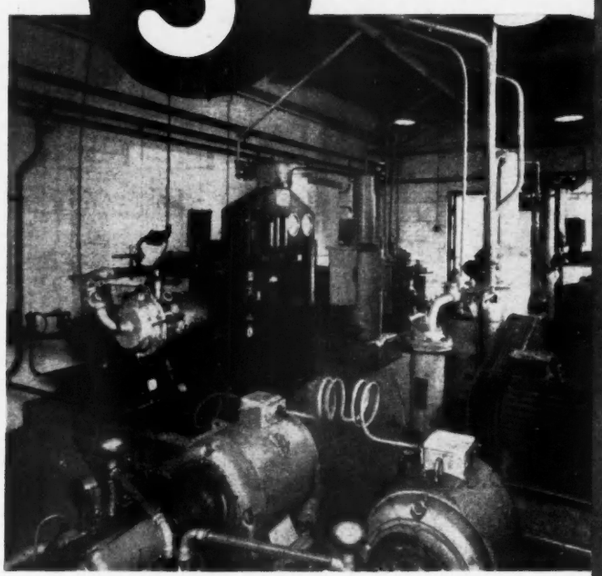

Two Holmes-Kemp Inert Gas Generators installed at the Speke Works, Liverpool, of Messrs. Beck Koller & Co. (England) Ltd. Each of these machines is capable of producing 3,000 cubic feet of gas per hour.

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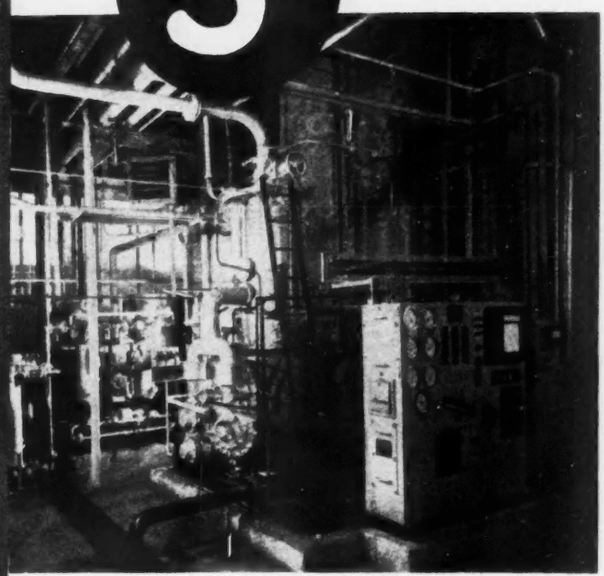

A Holmes-Kemp Nitrogen Generator installed at the Hythe Works of The International Synthetic Rubber Co. Ltd. This machine is capable of producing 3,000 cubic feet of dry nitrogen gas per hour at a pressure of 150 p.s.i.g.

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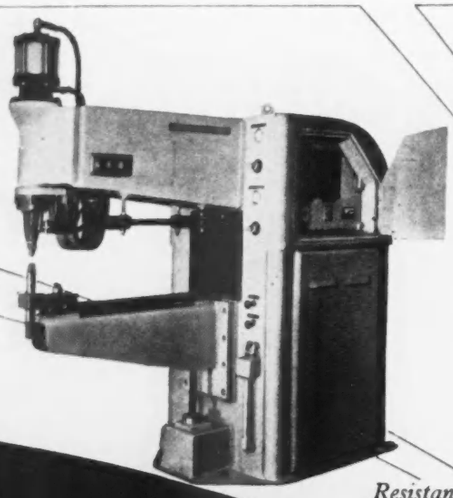
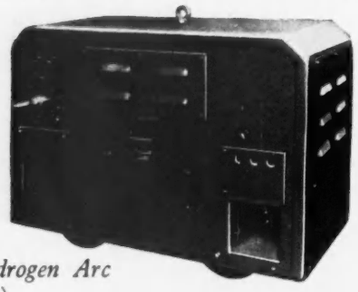


Resistance



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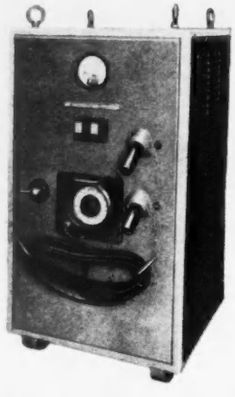
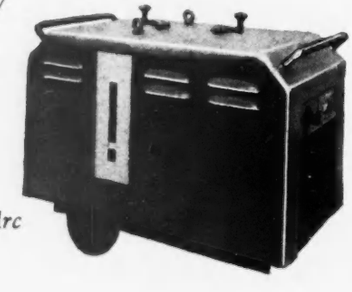
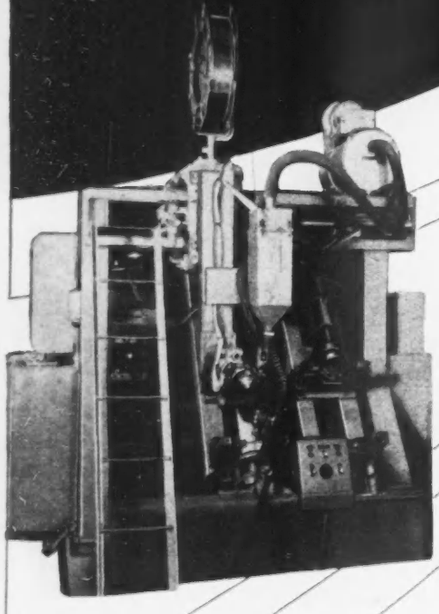


D.C. Rectifier Arc



Inert Gas Arc



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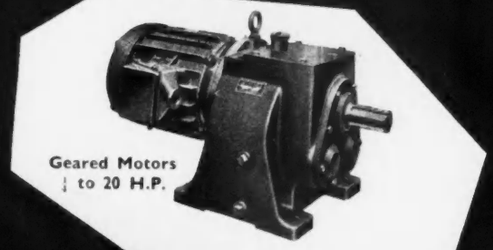

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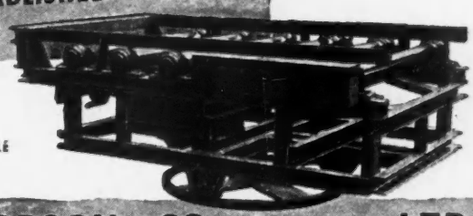

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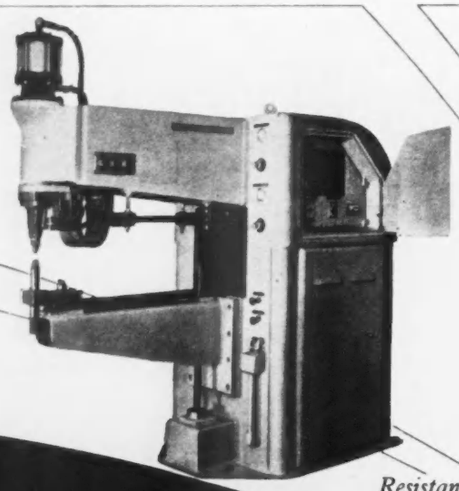
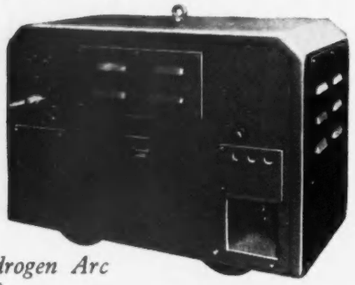


Resistance



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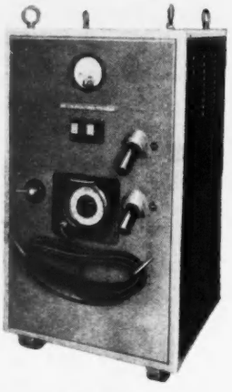

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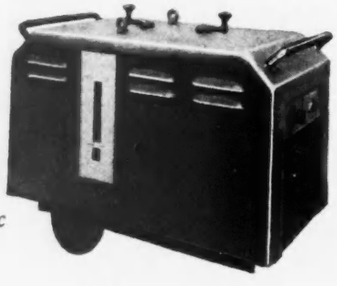
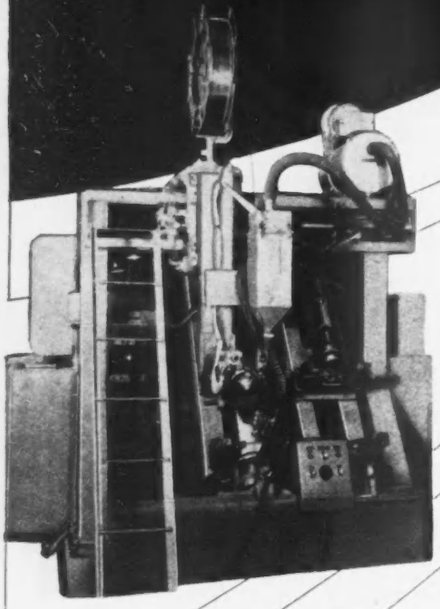


Inert Gas Arc



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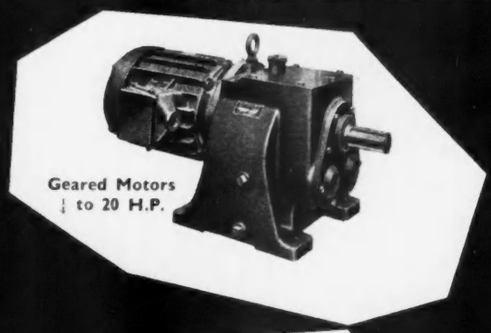

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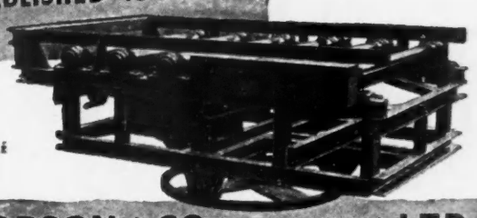

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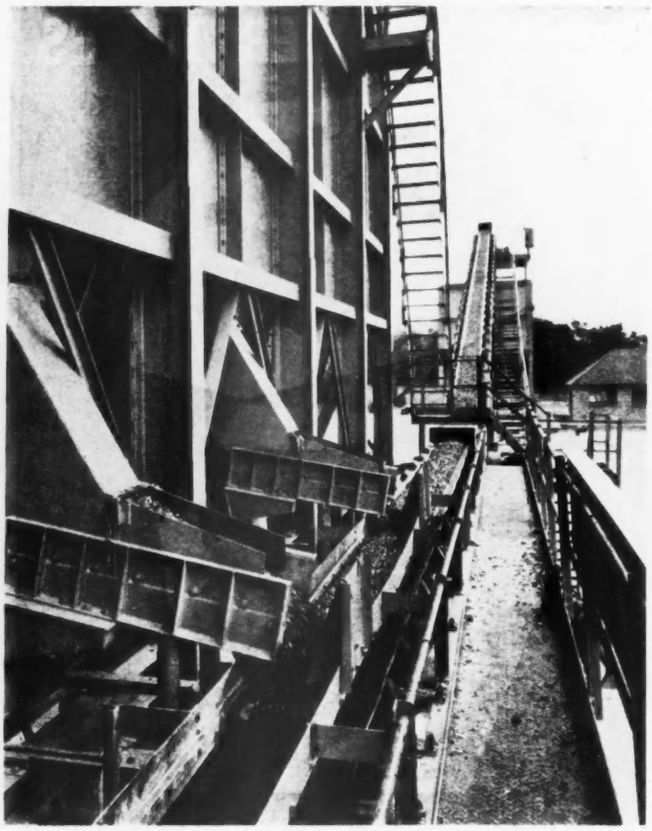

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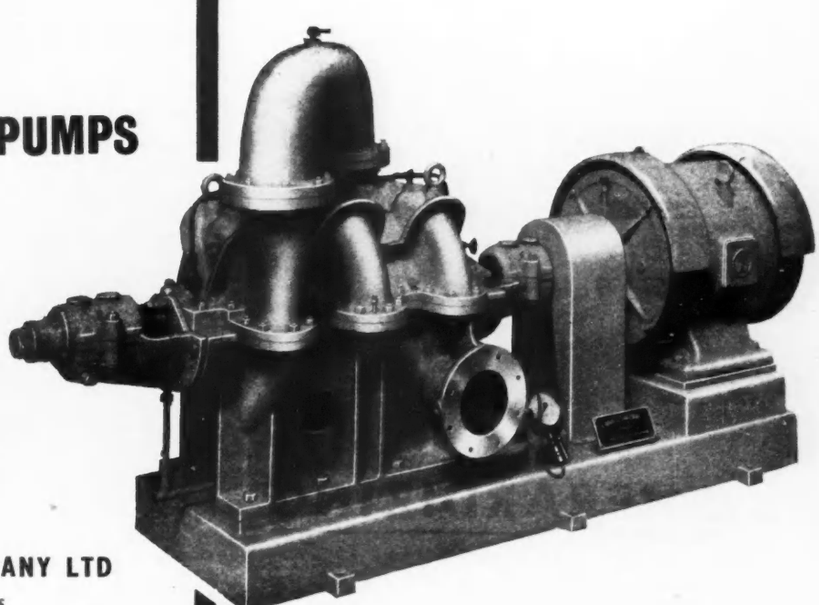

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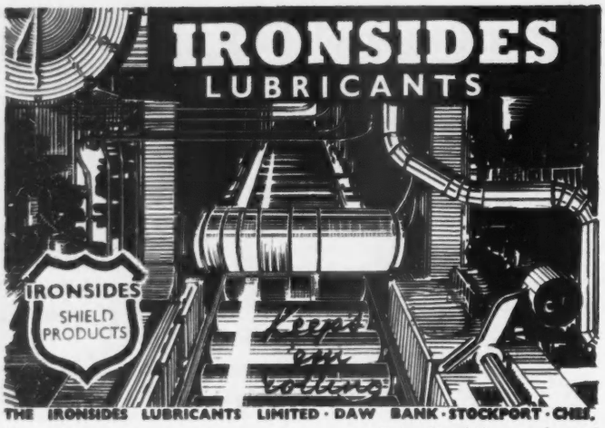

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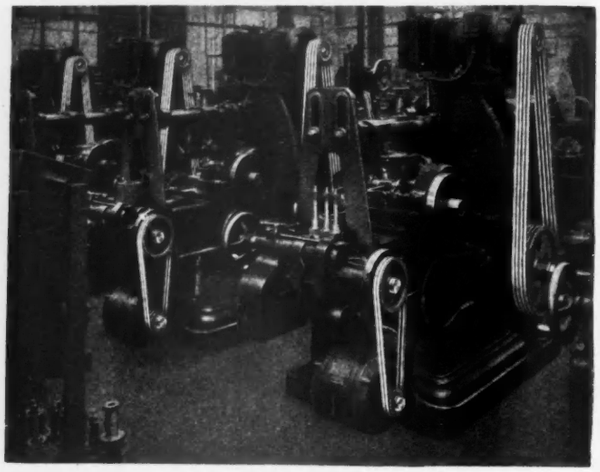

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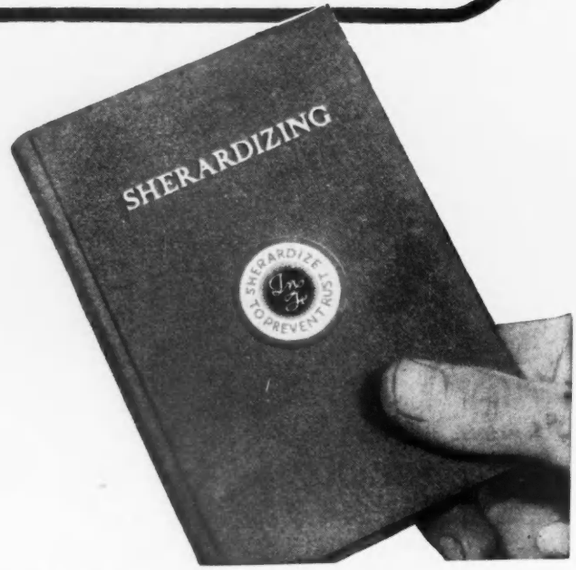

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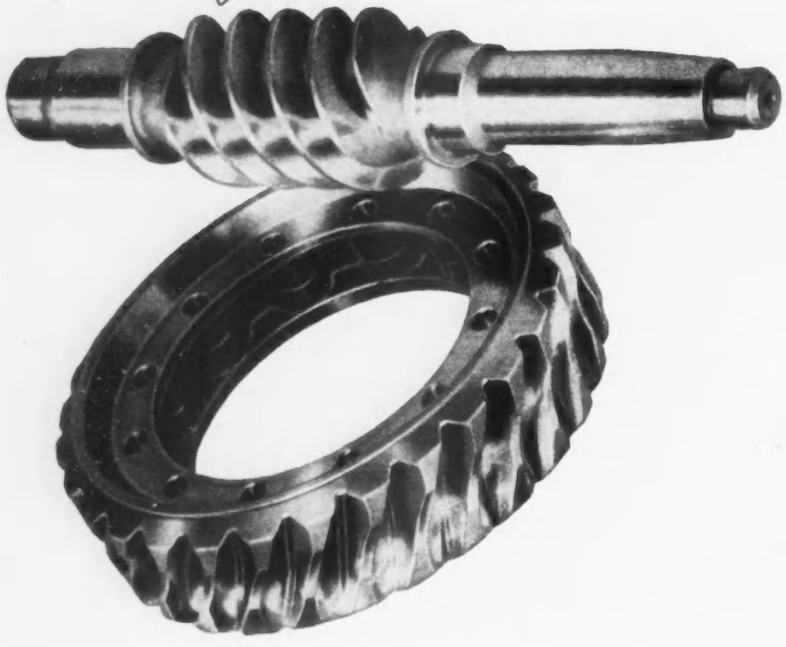

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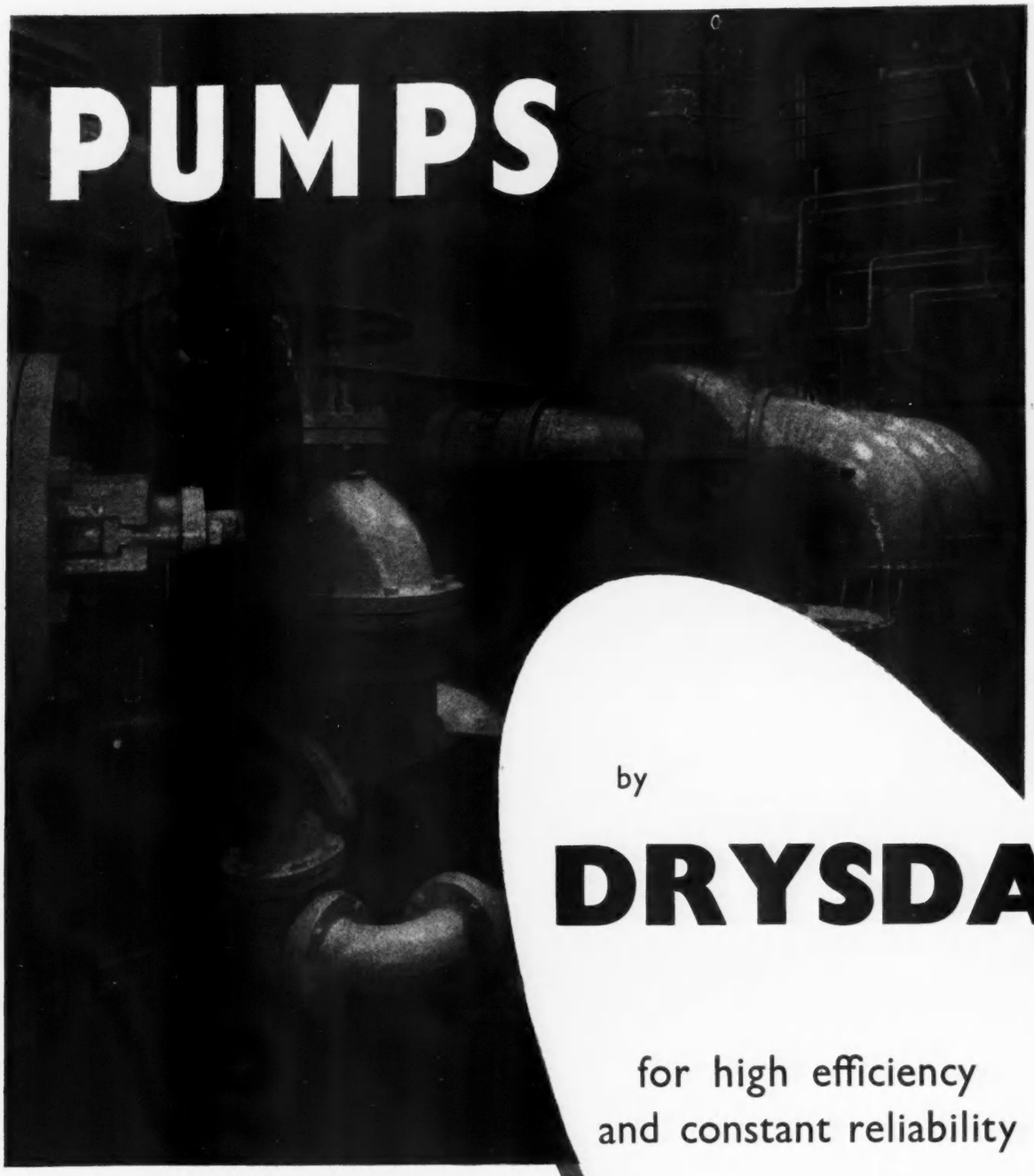

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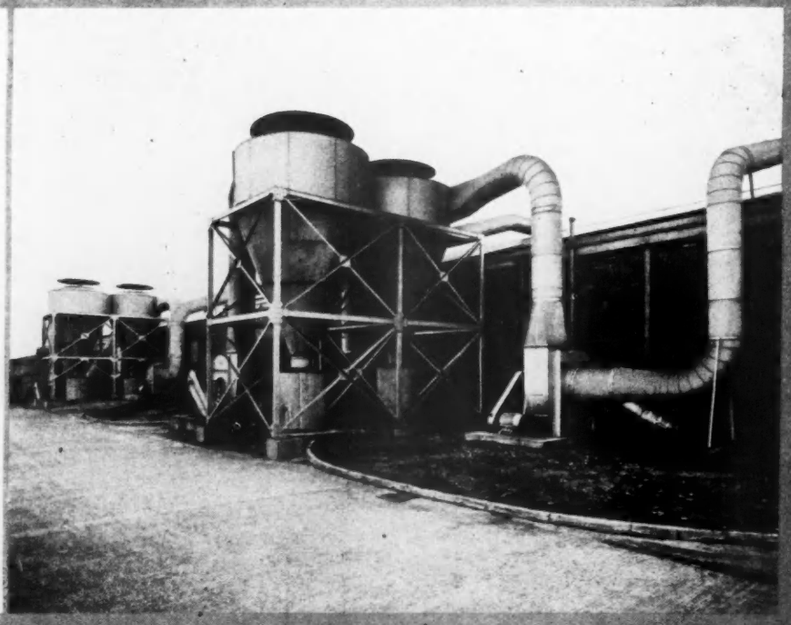

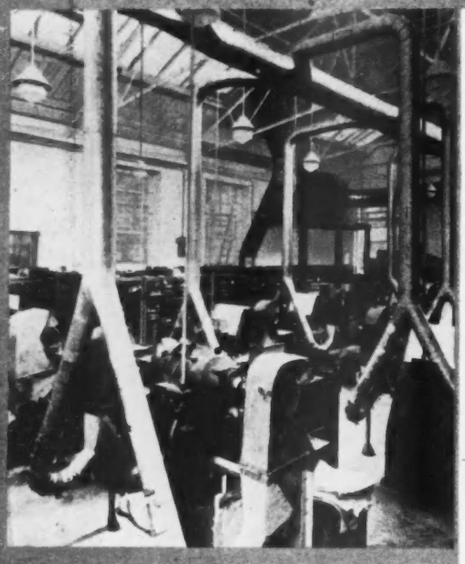

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M 203 B	3 / S	54— 96	750—1200	$5^1/_2$	$8^1/_4$	591.9	2150
M 204 B	4 / S	72— 126	750—1200	$5^1/_2$	$8^1/_4$	789.0	2715
OM 636	4 / S	17— 35	1500—3000	$2^{15}/_{16}$	$3^{15}/_{16}$	107.8	495
OM 312	6 / S	47— 77	1500—2400	$3^9/_{16}$	$4^3/_4$	279.5	990
OM 321	6 / S	55— 94	1500—2600	$3^3/_4$	$4^3/_4$	311.2	1025
OM 315	6 / S	80— 124	1200—1800	$4^7/_{16}$	$5^1/_2$	505.0	1875
OM 326	6 / S	97— 155	1200—1800	$5^3/_{64}$	$5^1/_2$	660.0	1720
MB 846 A	6 / S	114— 250	750—1500	$5^7/_8$	$7^1/_2$	1230.2	3860
MB 846 B	6 / L	114— 250	750—1500	$5^7/_8$	$7^1/_2$	1230.2	3970
MB 846 Ab[1]	6 / S	148— 320	750—1500	$5^7/_8$	$7^1/_2$	1230.2	4080
MB 846 Bb[1]	6 / L	148— 320	750—1500	$5^7/_8$	$7^1/_2$	1230.2	4200
MB 846 Ad[2]	6 / S	148— 320	750—1500	$5^7/_8$	$7^1/_2$	1230.2	4200
MB 836 B	6 / S	230— 350	1000—1500	$6^7/_8$	$8^1/_{16}$	1806.3	4380
MB 836 Bb[1]	6 / S	305— 500	1000—1500	$6^7/_8$	$8^1/_{16}$	1806.3	4830
MB 836 Db[3]	6 / S	370— 650	1000—1500	$6^7/_8$	$8^1/_{16}$	1806.3	5050
MB 820 B	12 / SV	460— 700	1000—1500	$6^7/_8$	$8^1/_{16}$	3612.6	6180
MB 820 Bb[1]	12 / SV	610—1000	1000—1500	$6^7/_8$	$8^1/_{16}$	3612.6	6900
MB 820 Db[3]	12 / SV	770—1350	1000—1500	$6^7/_8$	$8^1/_{16}$	3612.6	7240
MB 837 A	8 / SV	165— 440	850—2000	$6^1/_2$	$6^7/_8$	1825	2940
MB 837 Aa[1]	8 / SV	240— 550	850—2000	$6^1/_2$	$6^7/_8$	1825	3020
MB 839 Ab[1]	16 / SV	1145—1800	1000—1500	$7^1/_2$	$9^1/_{16}$	6380	11020
MB 839 Bb[3]	16 / SV	1380—2350	1000—1500	$7^1/_2$	$9^1/_{16}$	6380	11450
MB 518 [1]	20 / SV	3000	1720	$7^5/_{16}$	$9^{13}/_{16}$	8201.5	10550

S = vertical; L = horizontal; V = vee type; [1] = supercharged; [2] = supercharged and with boost intercooling [3] = with high boosting and boost intercooling.

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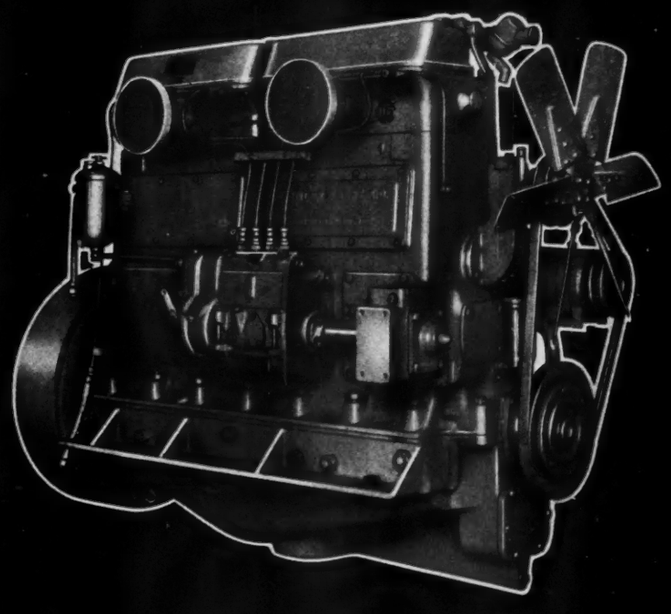

973 MAI

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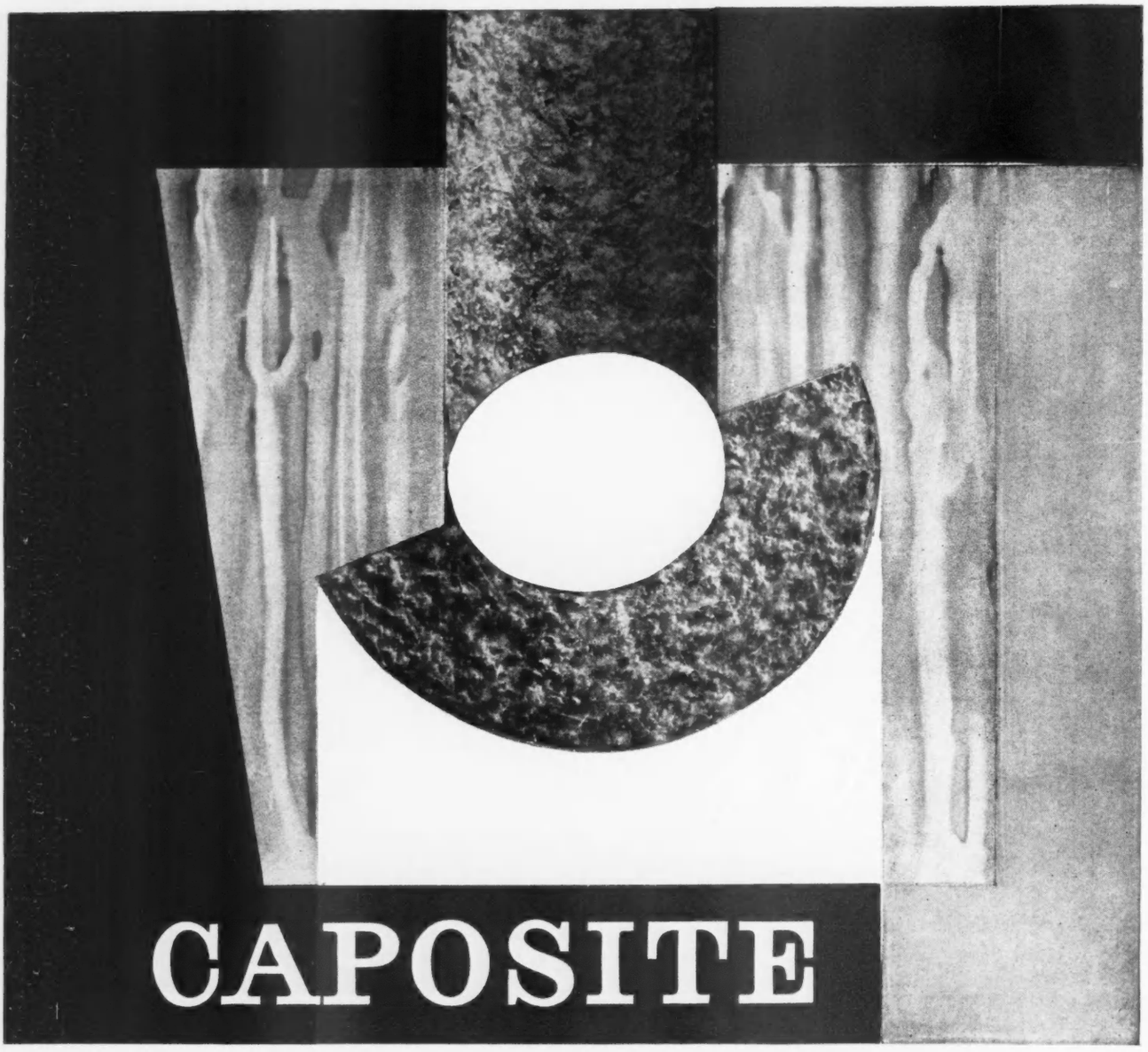

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NEWCASTLE: 19 & 20 Exchange Buildings, Newcastle, Newcastle 20488

TA1631

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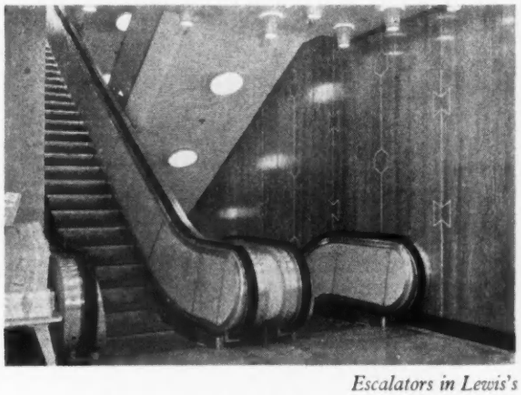
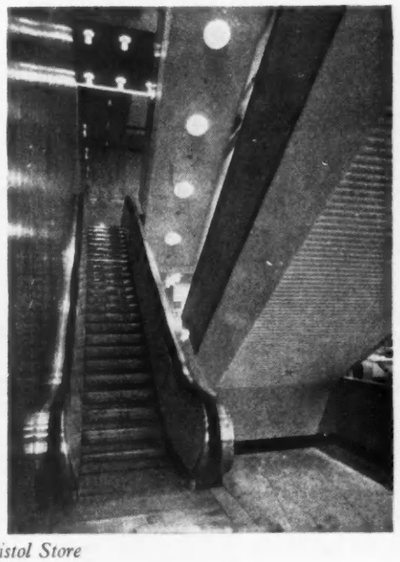
TEN ESCALATORS for Lewis's, Bristol

The new super-modern store opened in Bristol by Lewis's, and claimed to be the finest in Europe, is equipped with ten J. & E. Hall Escalators for up-and-down travel between the five floors. Sixteen more are also operating in their Liverpool store.





Escalators in Lewis's new Bristol Store

J. & E. Hall Limited

ESCALATOR, LIFT & REFRIGERATION ENGINEERS

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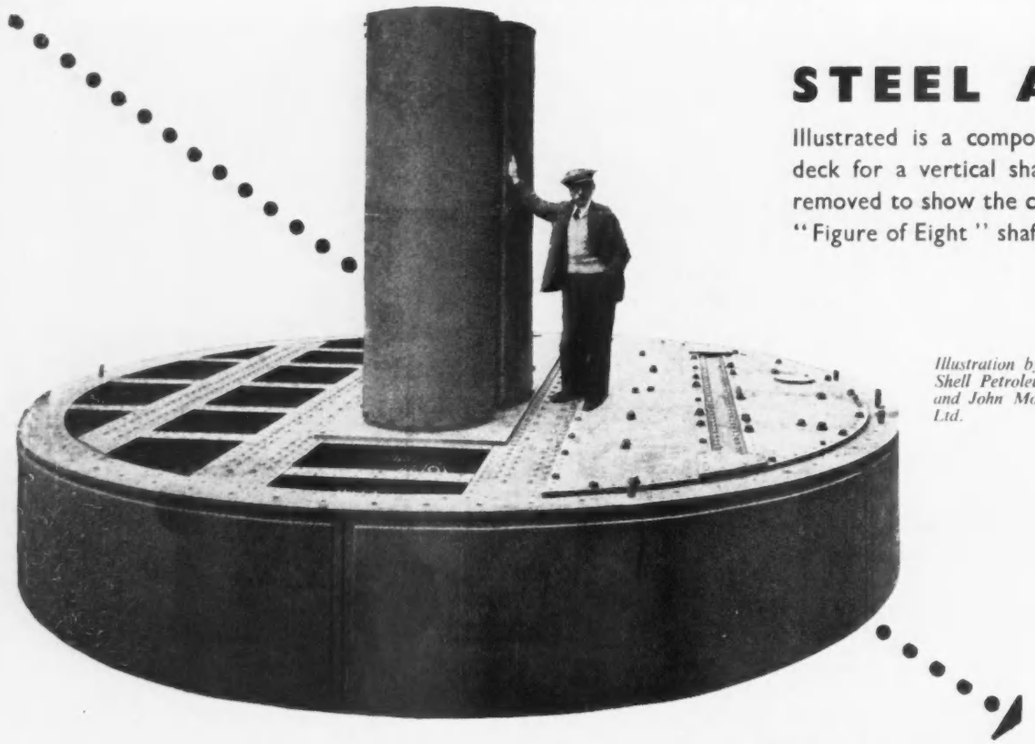

STEEL AIR DECK

Illustrated is a composite riveted and welded air deck for a vertical shaft, with some of the plates removed to show the construction. One section of "Figure of Eight" shaft is shown in position.

Illustration by courtesy of Shell Petroleum Co. Ltd., and John Mowlem & Co Ltd.

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This indoor Mine Car layout at a Scottish Colliery is an example of the versatility of Summersons designing and manufacturing resources. Laid on a stepped concrete floor, the 3ft. 0in. gauge 50 lb. F.B. Rail Tracks are fastened to transverse steel channel sleepers bolted to longitudinal steel joists or plate girders, by which means the appropriate gradients are obtained. Cars are gravity operated and the switches electrically controlled from a central panel.

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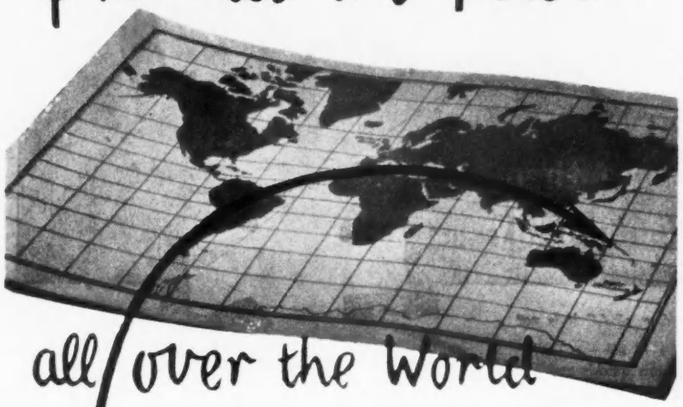
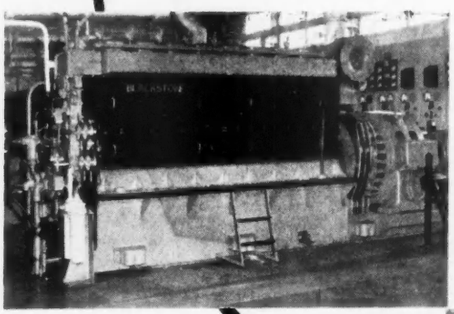


all over the World



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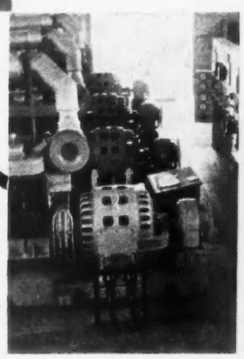
New Britain, electricity is supplied by four 320 kW alternators, each powered by a Lister Blackstone EVS8 480 h.p. diesel engine.



Photos by courtesy of the Commissioners of Australia Dept. of Works & Housing.

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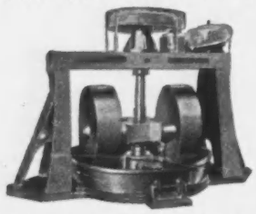

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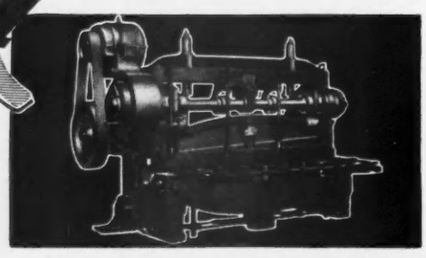

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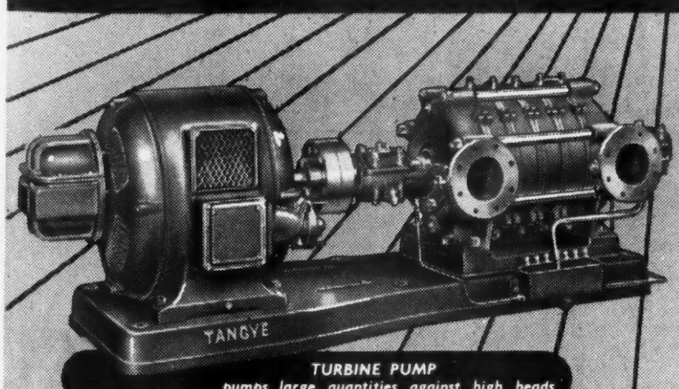
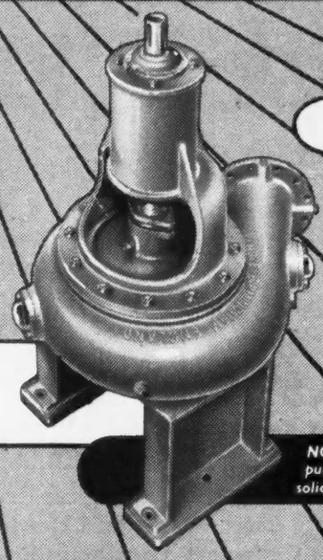
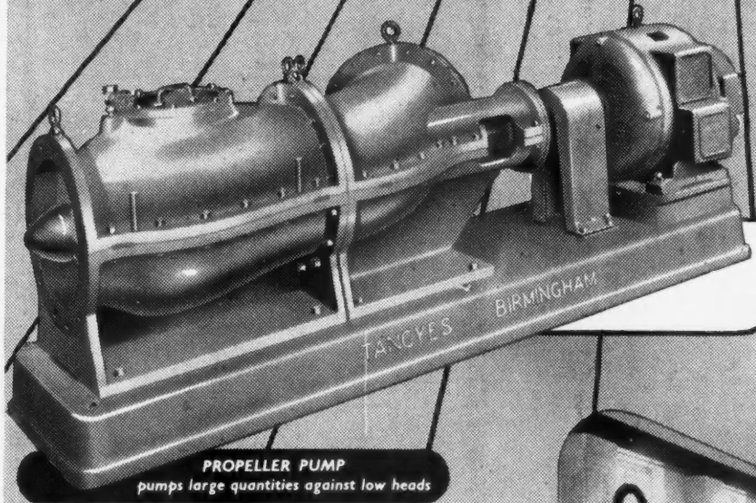
PUMPS WITH A PURPOSE . . .



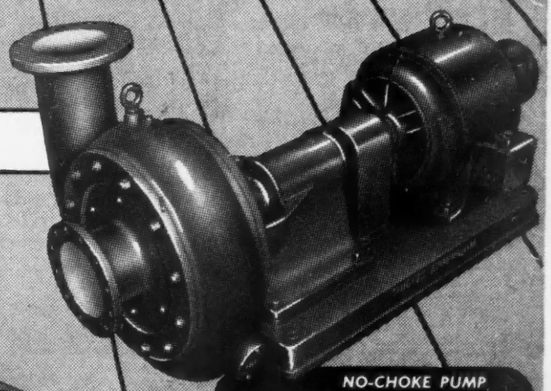
TURBINE PUMP
pumps large quantities against high heads



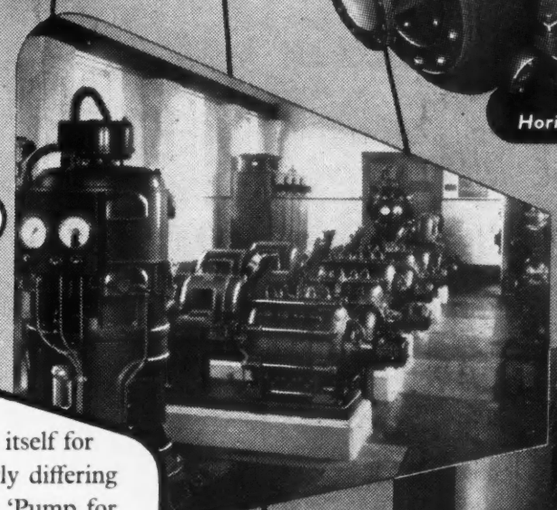
NO-CHOKE PUMP
pumps liquids with solids in suspension

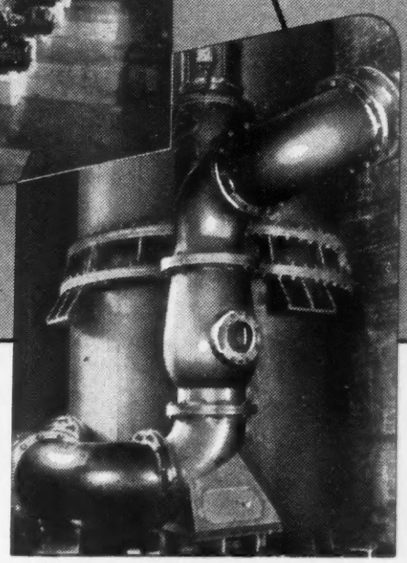


PROPELLER PUMP
pumps large quantities against low heads



NO-CHOKE PUMP
Horizontal version of above





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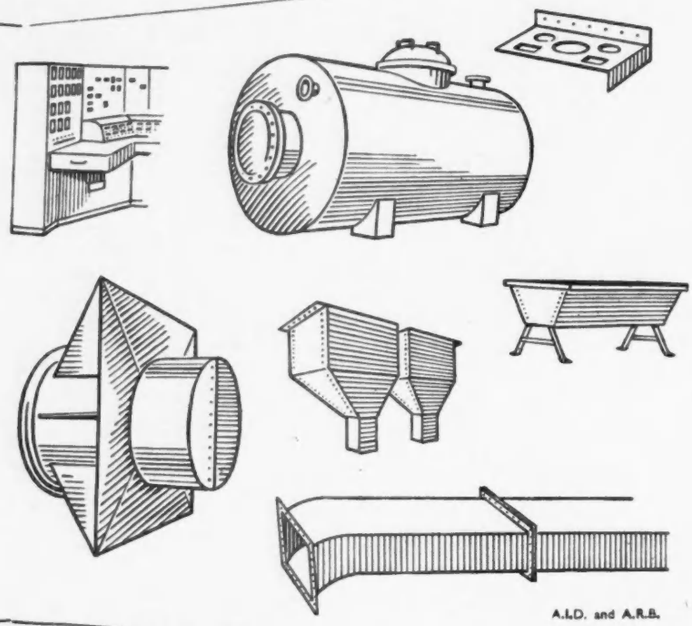

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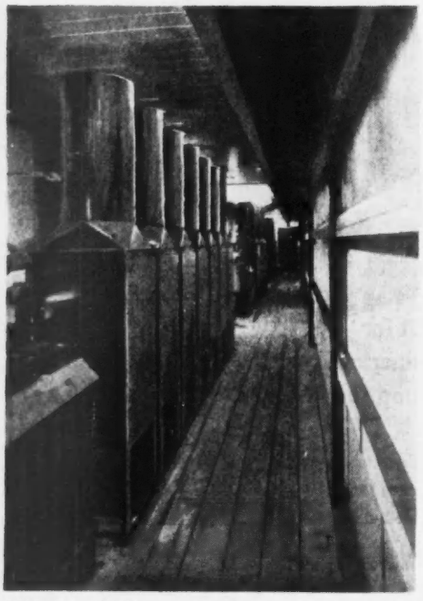
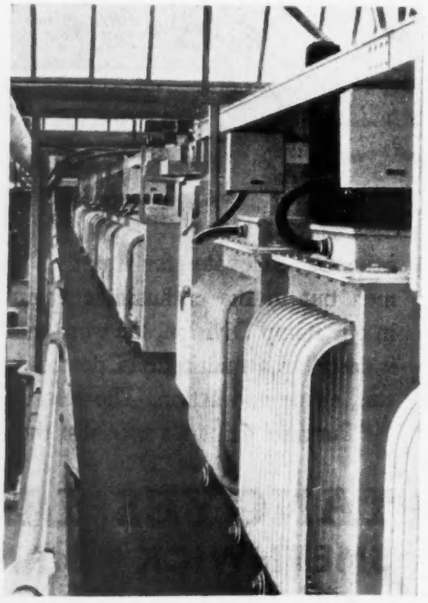


1936 *16 000 amperes of copper-oxide rectifiers installed for Copper Sheets, Birmingham.*



1958 *Part of a 182 000 ampere Westalite oil-immersed rectifier installation by W. Canning & Co. Ltd., at Vauxhall Motors Ltd., Luton.*

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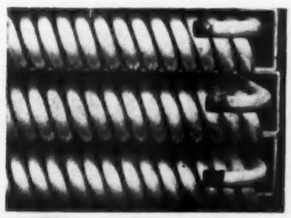
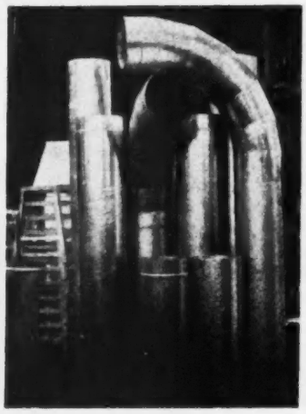
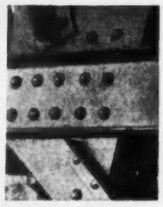


HOT GALVANIZING



FIRST MAKES STEEL LAST



For further information write to
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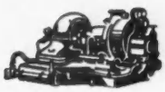

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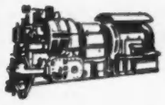

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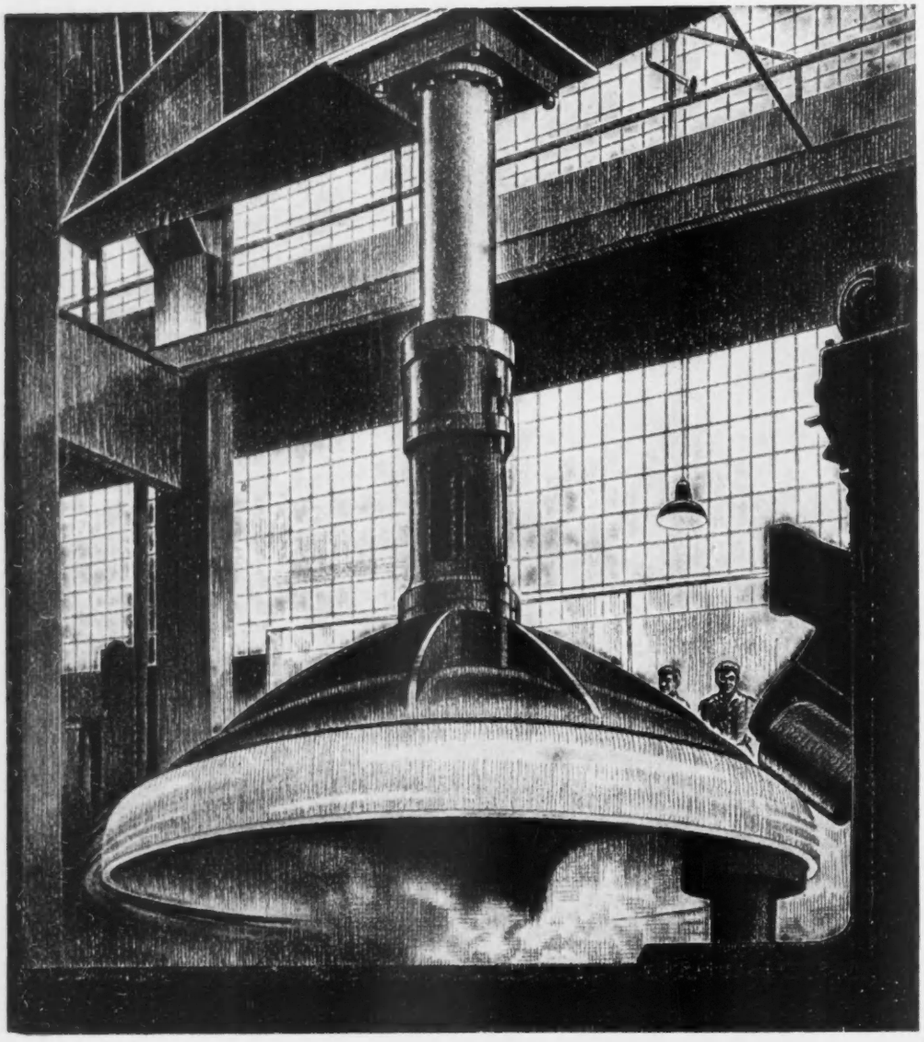

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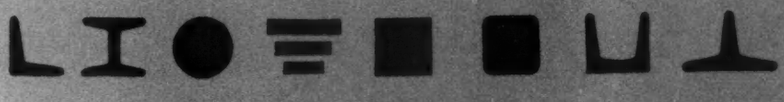

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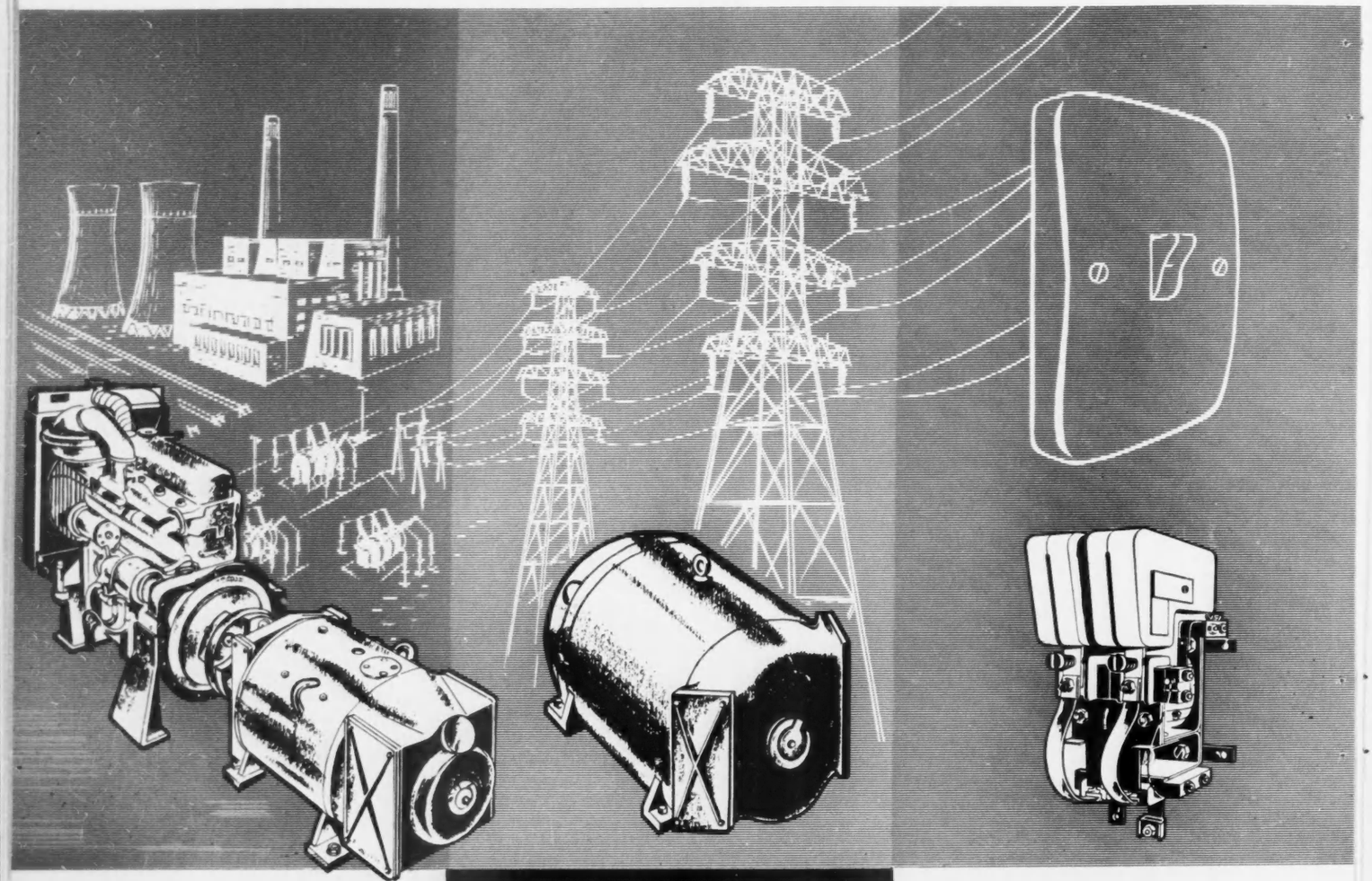

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The simple, positive, quick acting heavy duty contactor—

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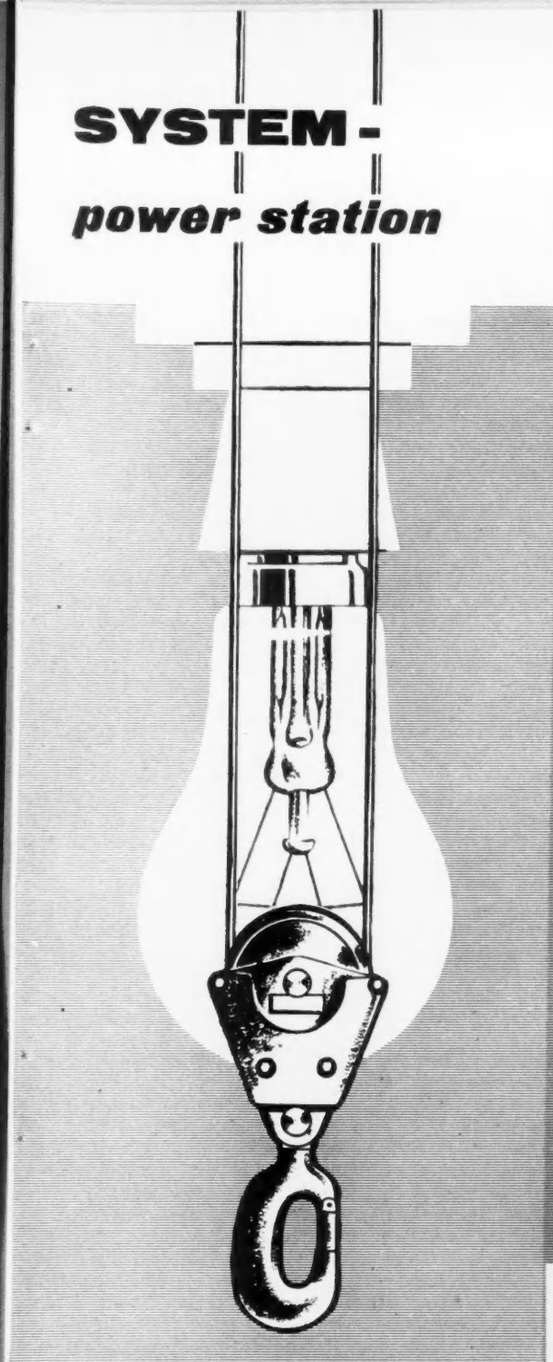

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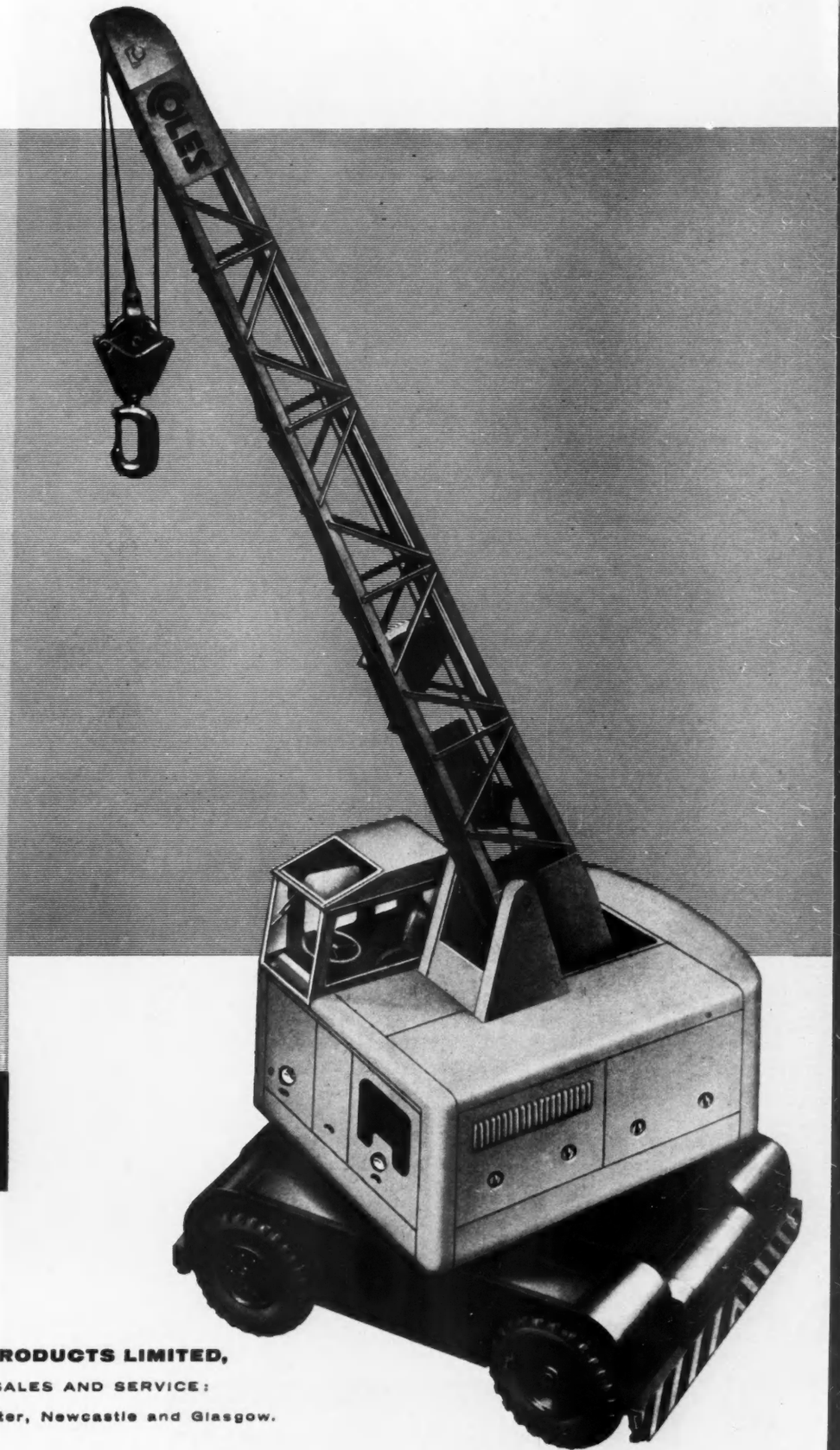

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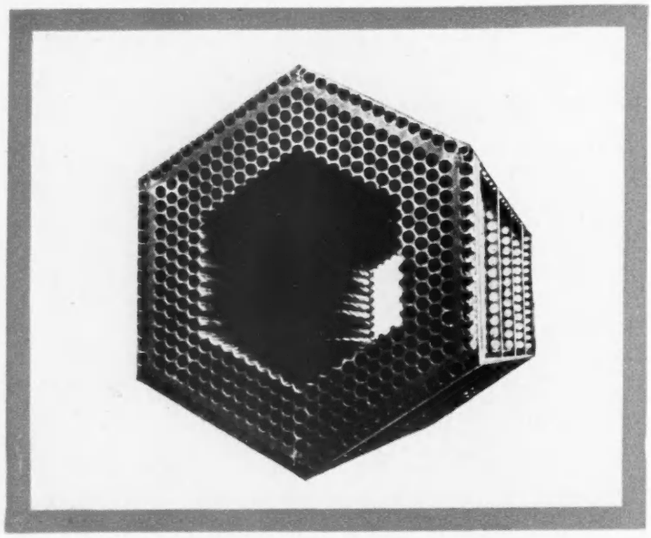

and THIS...

(Gagging Skirt for the Dounreay fast nuclear reactor manufactured completely in stainless steel 18/8/1 and weighing 30 cwt.)

Capacity includes:

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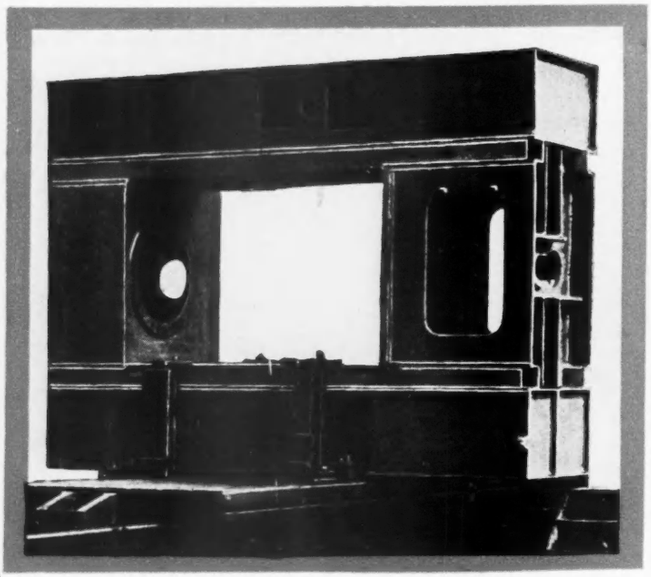
Test procedures, which include X-ray, vacuum and ultrasonic, can also take advantage of specialised techniques developed by other members of the Fairey Group.

Standards met include AID, ARB, UKAEA, Lloyd's Class 1.



is now available for jobs like THIS...

(Steel fabricated frame for a 200-ton Himulti double-action press.)

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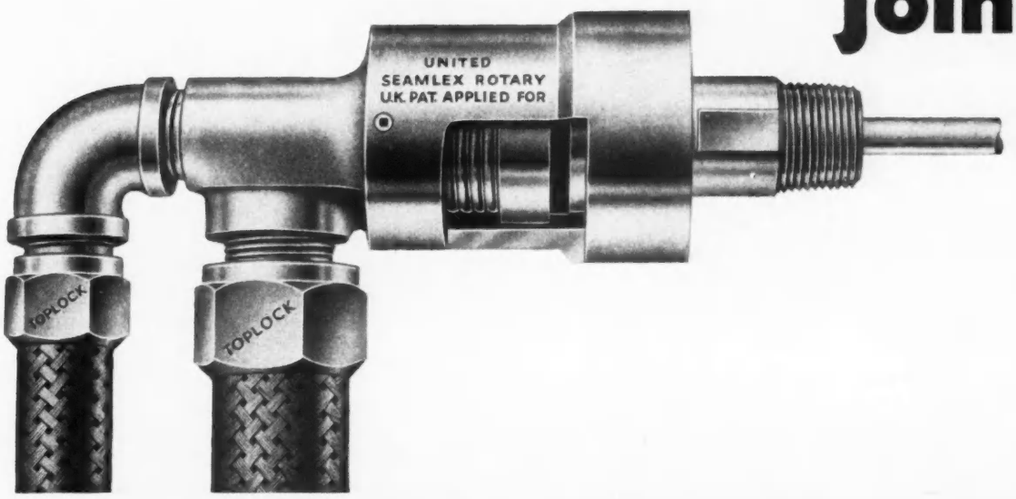
The United Seamlex Rotary Joint



FOR STEAM, WATER, AIR, VACUUM

The Seamlex Rotary Joint is light in weight, compact, easy to install, easy to repair and economical.

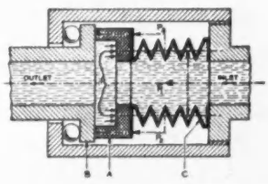
The United Seamlex Rotary Joint is manufactured under licence from The Seamlex Company of Long Island City, New York.

with Triple Protection against Leakage

1

PRESSURE EQUALIZING CHAMBER

UNITED SEAMLEX ROTARYS maintain their steady leak-proof performances under higher pressures because . . . regardless of the pressure in the supply line, the Pressure Equalizing Chamber automatically *reduces* the pressure to the minimum required for continuous, leakproof operation. The automatically *reduced* pressures cause less friction, prolonging the life of the seal, as well as the rotary shaft, thus providing effective protection against leakage.



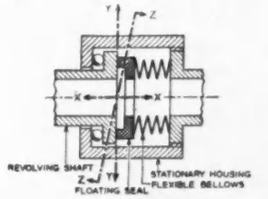
PRESSURE DIAGRAM

How working pressure P_1 + spring (Bellows) pressure P_2 is reduced by counterpressure P_3

2

FLOATING GRAPHITE SEAL

The Seamlex *Floating* Seal, being flexibly mounted by means of a metallic bellows, is self-aligning, permitting it to move freely in any direction, axially as well as radially and obliquely. The *Floating* Seal absorbs smoothly the impact that is exerted upon it by a misaligned revolving shaft.



FLOATING SEAL

Self-aligning in any direction, axially X–X, radially Y–Y and obliquely Z–Z.

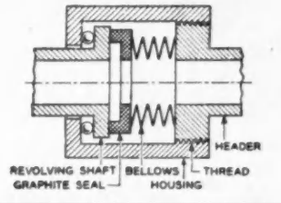
3

EXTERNAL PRESSURE ADJUSTMENT

This third exclusive feature contributes further to the continuous leakproof performance of United Seamlex Rotarys because . . .

It permits compensating for wear of graphite seal before leakage occurs—*without removal* of Seamlex Rotary from service.

Predetermined factory-adjustment—to meet your particular working pressure—eliminates excessive wear of seal and shaft.



SCREW ADJUSTMENT

The threaded engagement between header and housing permits the relative movement required for wear compensation and pressure regulation.

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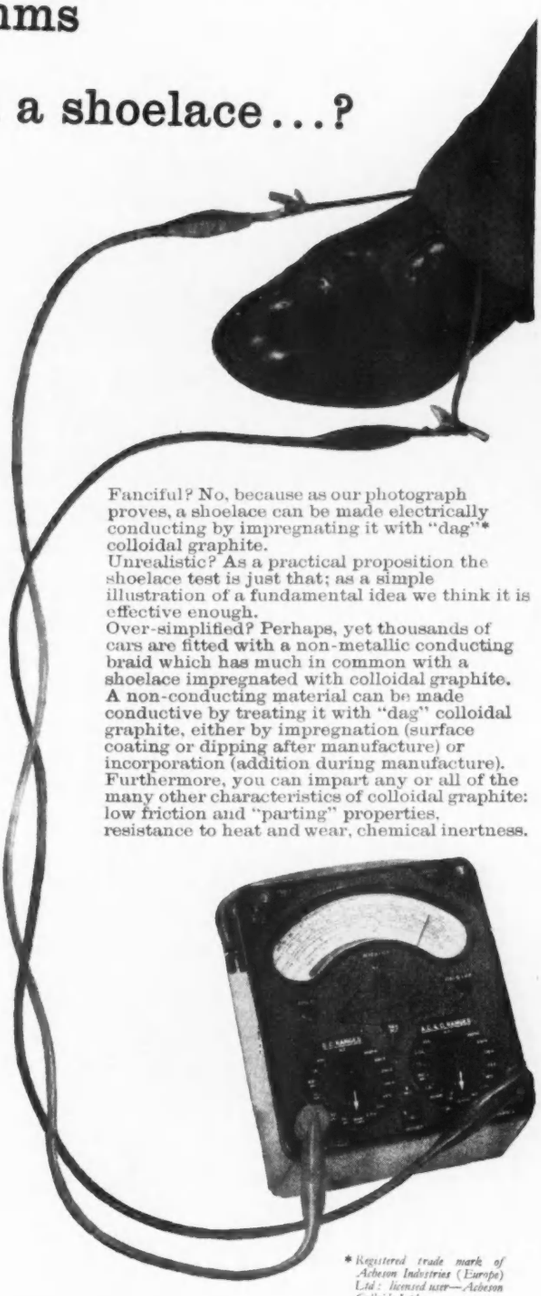
how many ohms in a shoelace...?



Fanciful? No, because as our photograph proves, a shoelace can be made electrically conducting by impregnating it with "dag"* colloidal graphite.
Unrealistic? As a practical proposition the shoelace test is just that; as a simple illustration of a fundamental idea we think it is effective enough.
Over-simplified? Perhaps, yet thousands of cars are fitted with a non-metallic conducting braid which has much in common with a shoelace impregnated with colloidal graphite.
A non-conducting material can be made conductive by treating it with "dag" colloidal graphite, either by impregnation (surface coating or dipping after manufacture) or incorporation (addition during manufacture).
Furthermore, you can impart any or all of the many other characteristics of colloidal graphite: low friction and "parting" properties, resistance to heat and wear, chemical inertness.

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If your problem is basically how to make plastics, natural or synthetic fibres, leather, cloth, paper or wood electrically conducting, then you should get in touch with us.

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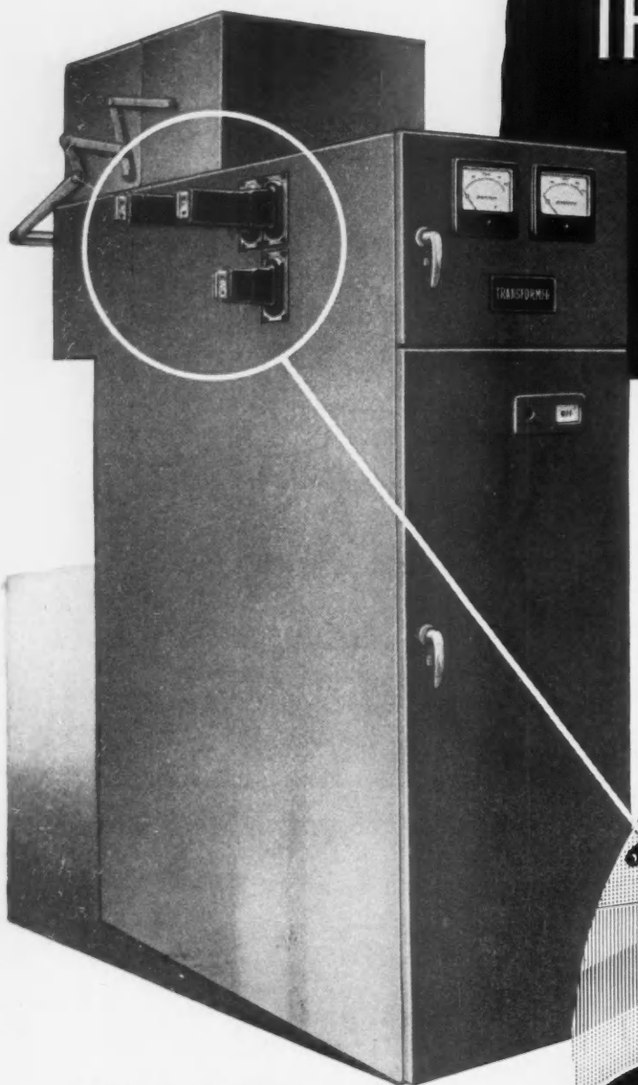
THE NEW ELLISON HIGH TENSION SWITCHGEAR



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ASTA CERTIFIED TO B.S. 116 : 1952

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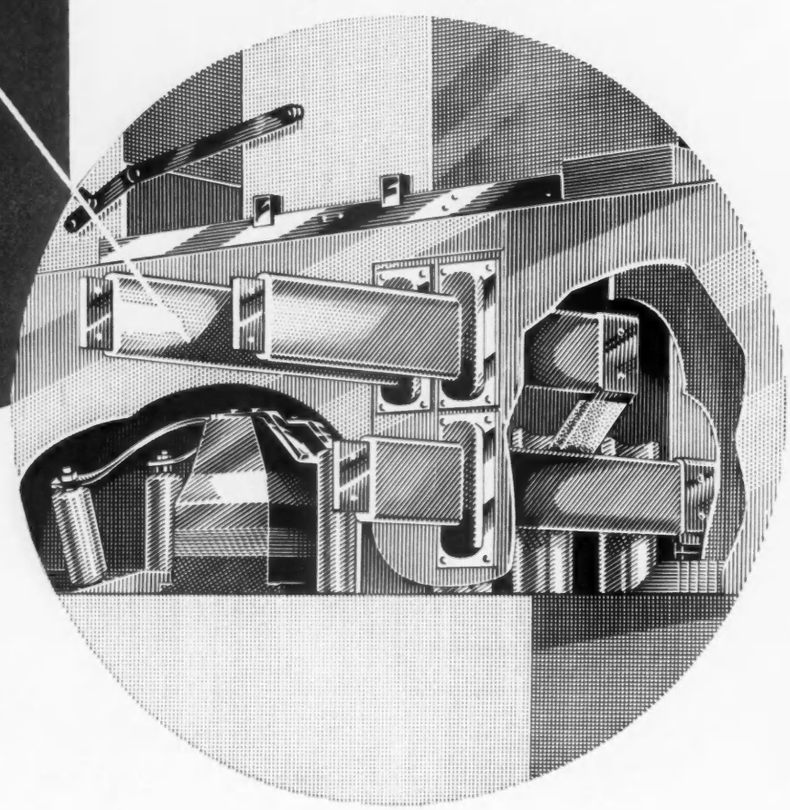
You really *must* know more about this new Ellison Switchgear. Modern in conception, it has many outstanding features.



THE BUSBARS,

for example, are "air-insulated" yet TUFNOL (Epoxy Resin) insulation is moulded on to each, the moulding extending to the earth support plate to prevent ionisation. Rated at 1200 amps continuously, each busbar is of 2½" x ⅜" section H.D.H.C. copper and is of unit length. The busbars in each cell are individually sealed off. Front access is obtained by the removal of a single cover at the rear of the meter compartment.

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We shall be glad to send further information or arrange for an engineer to call.

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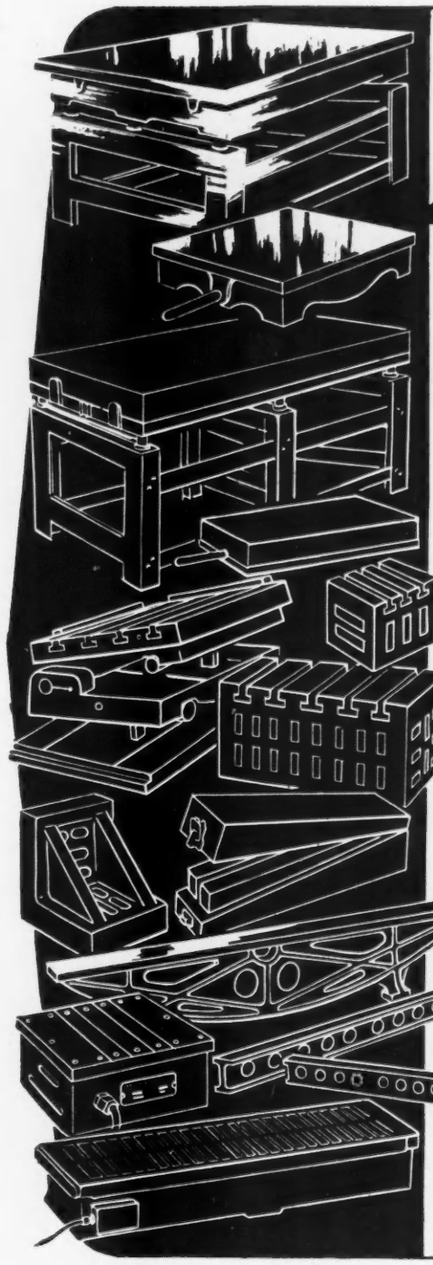

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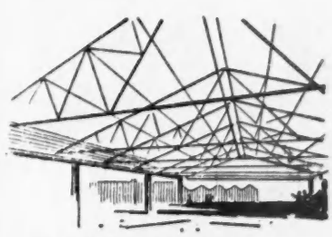

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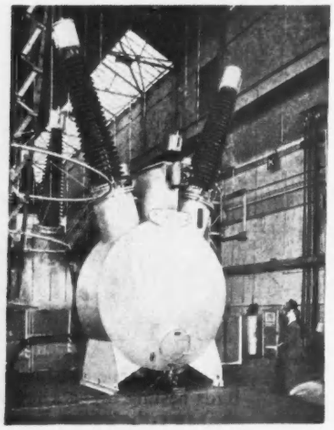

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

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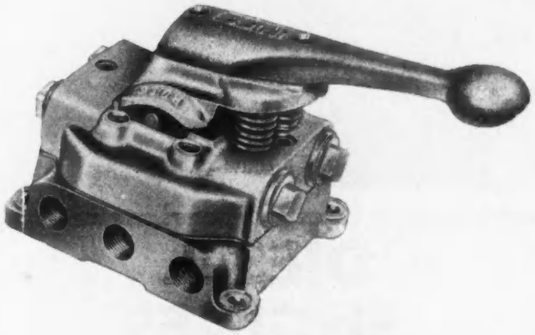

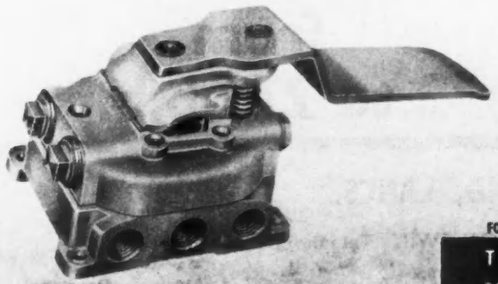

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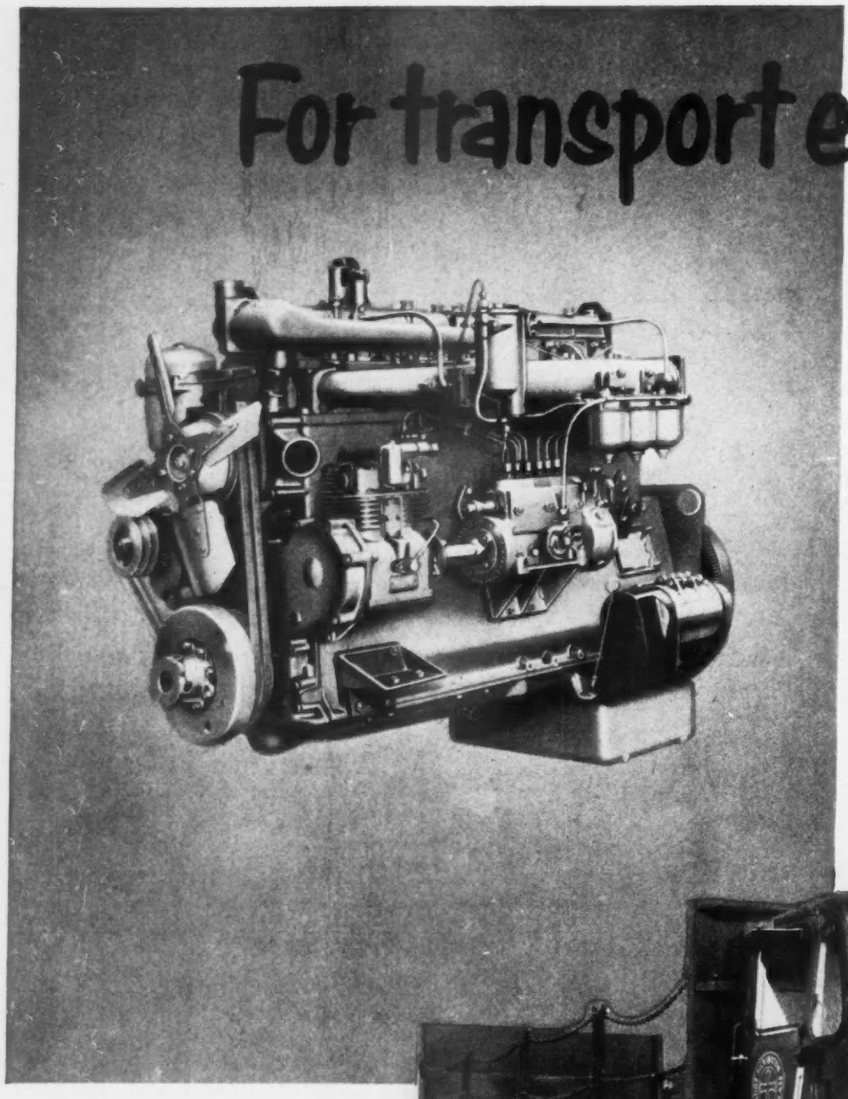

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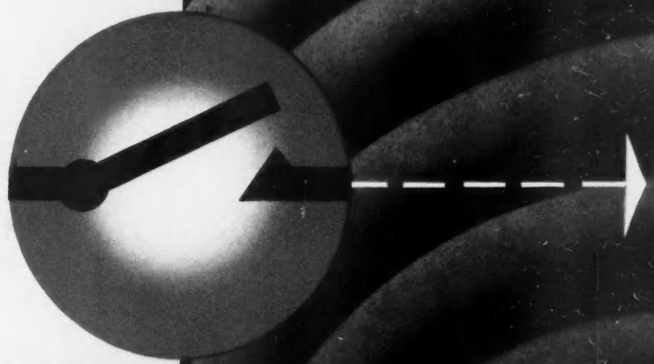

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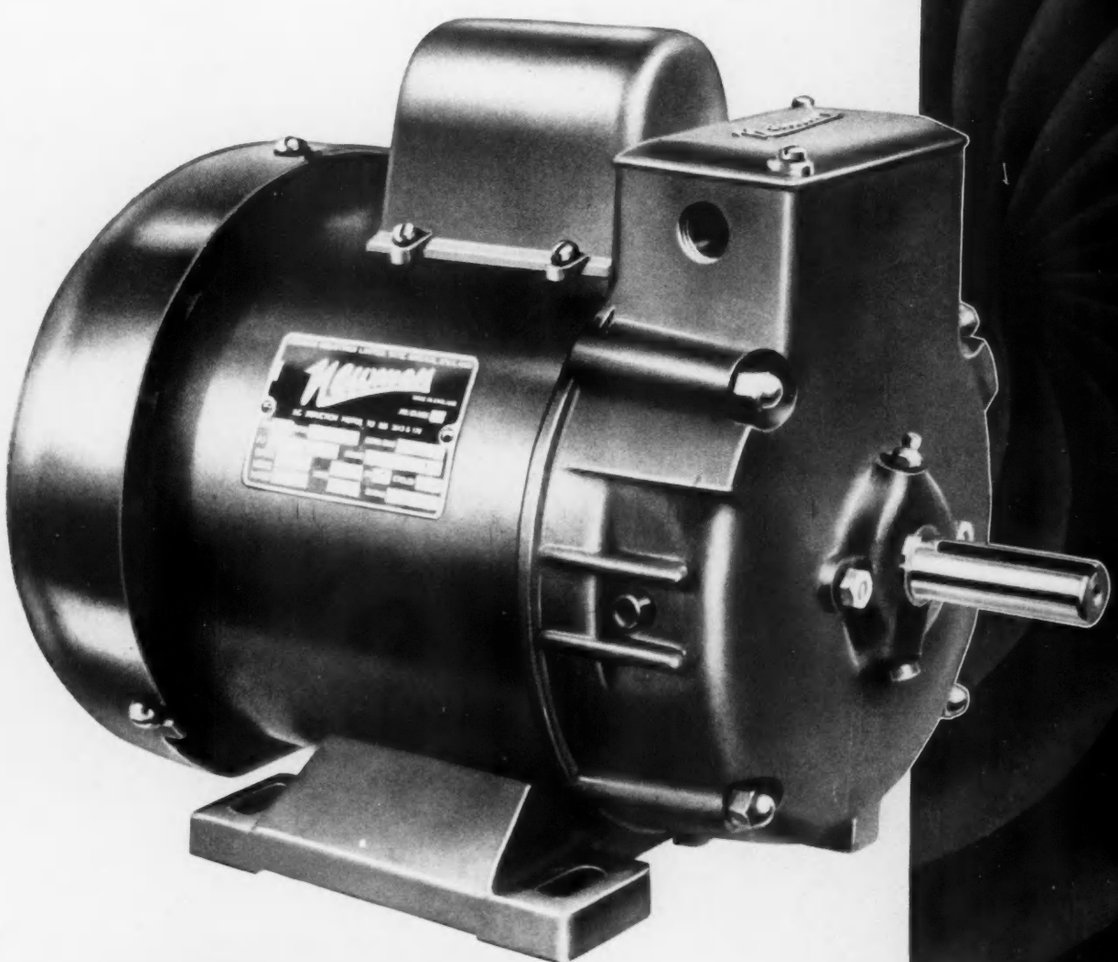

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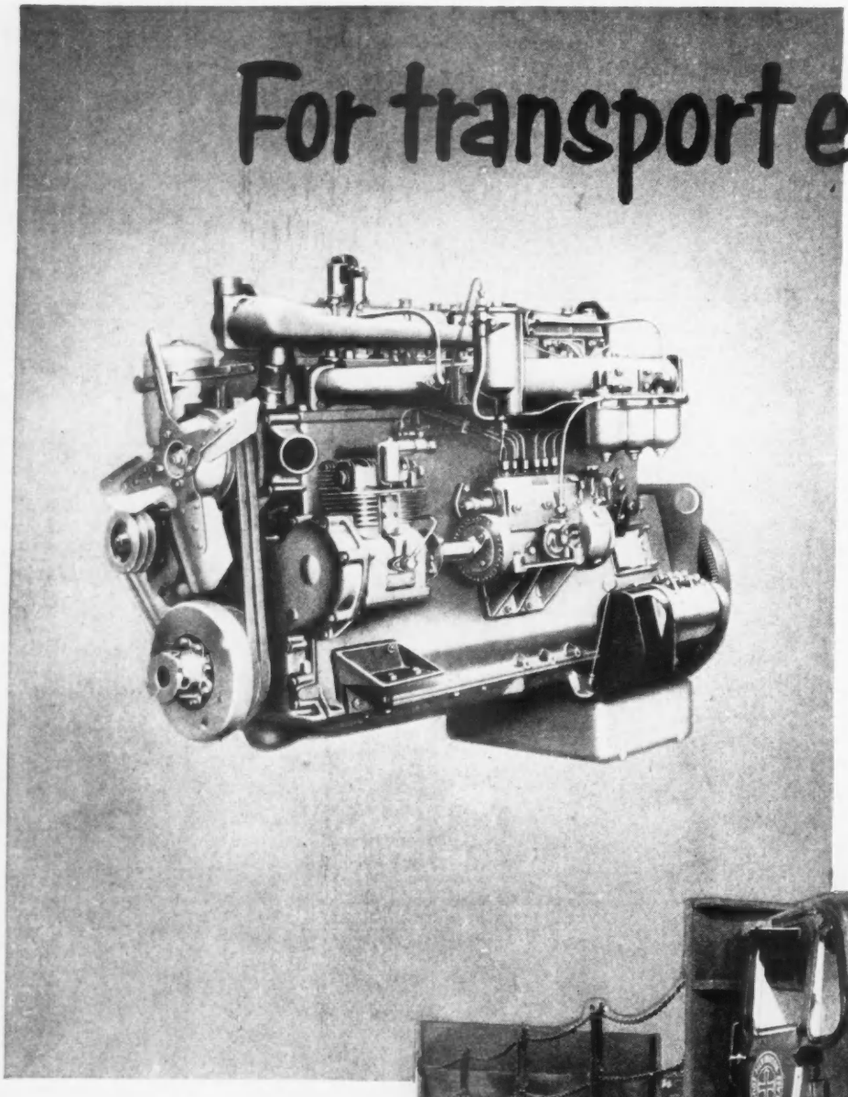

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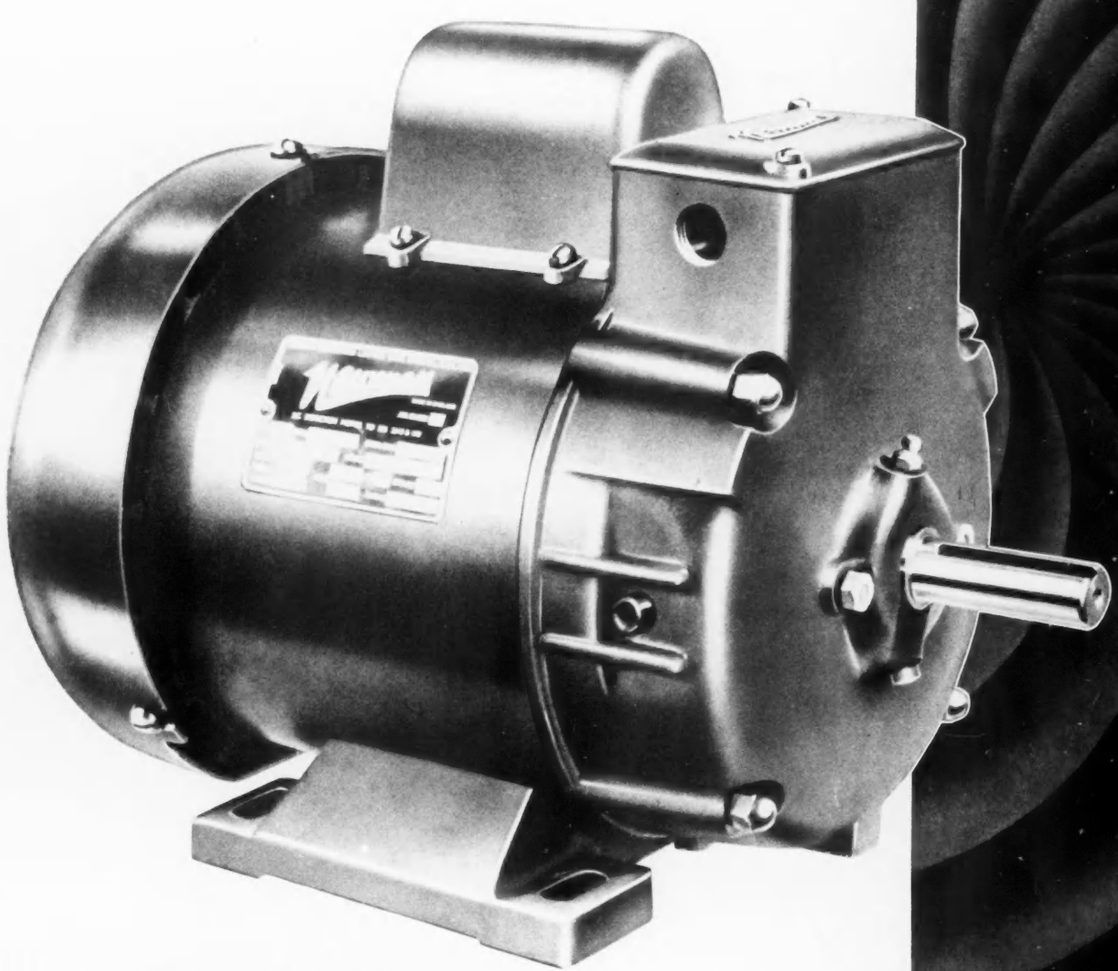
SWITCH DESIGN



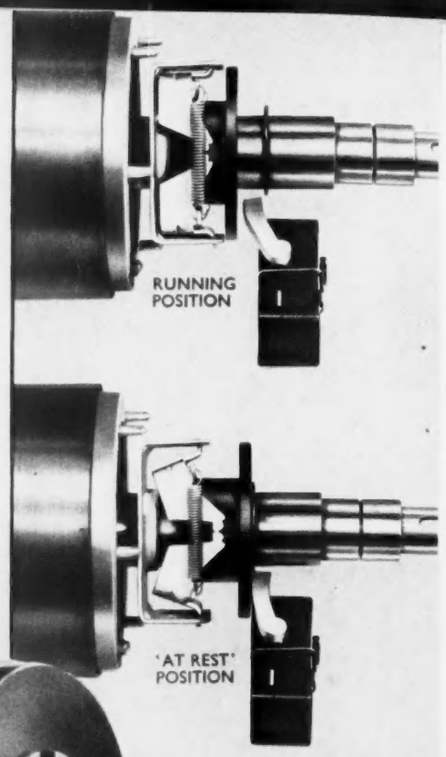
Newman

Making the pace in motor progress

THE ENGINEER
Oct. 30, 1959
62

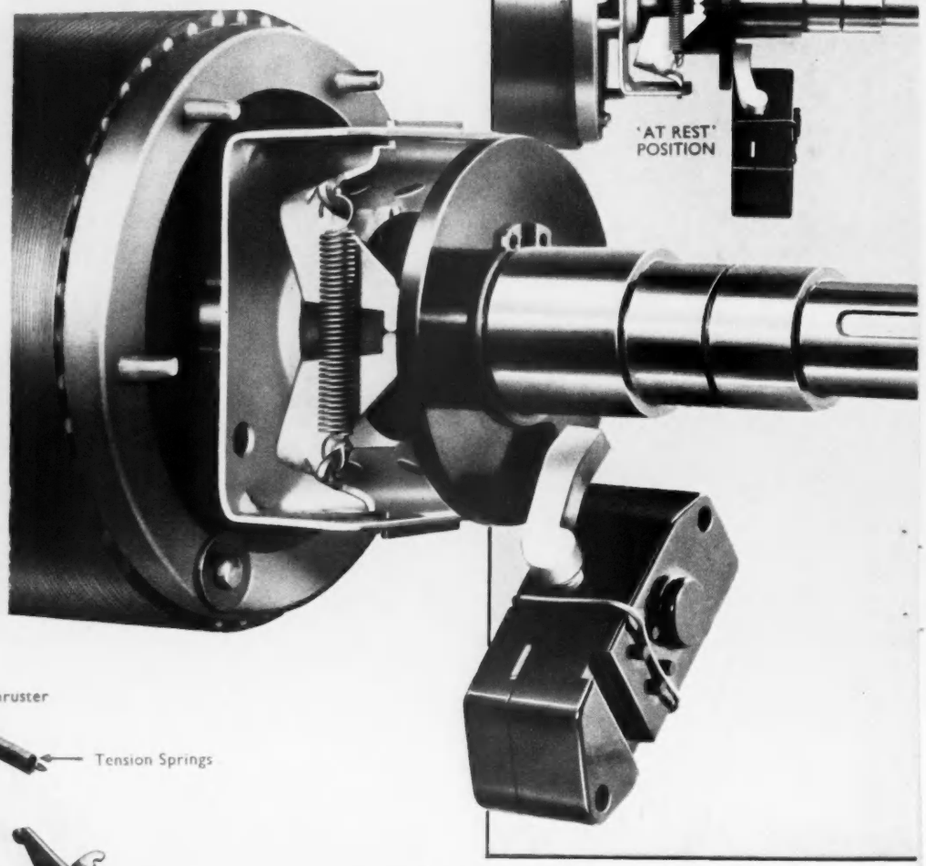
Newman SWITCH DESIGN

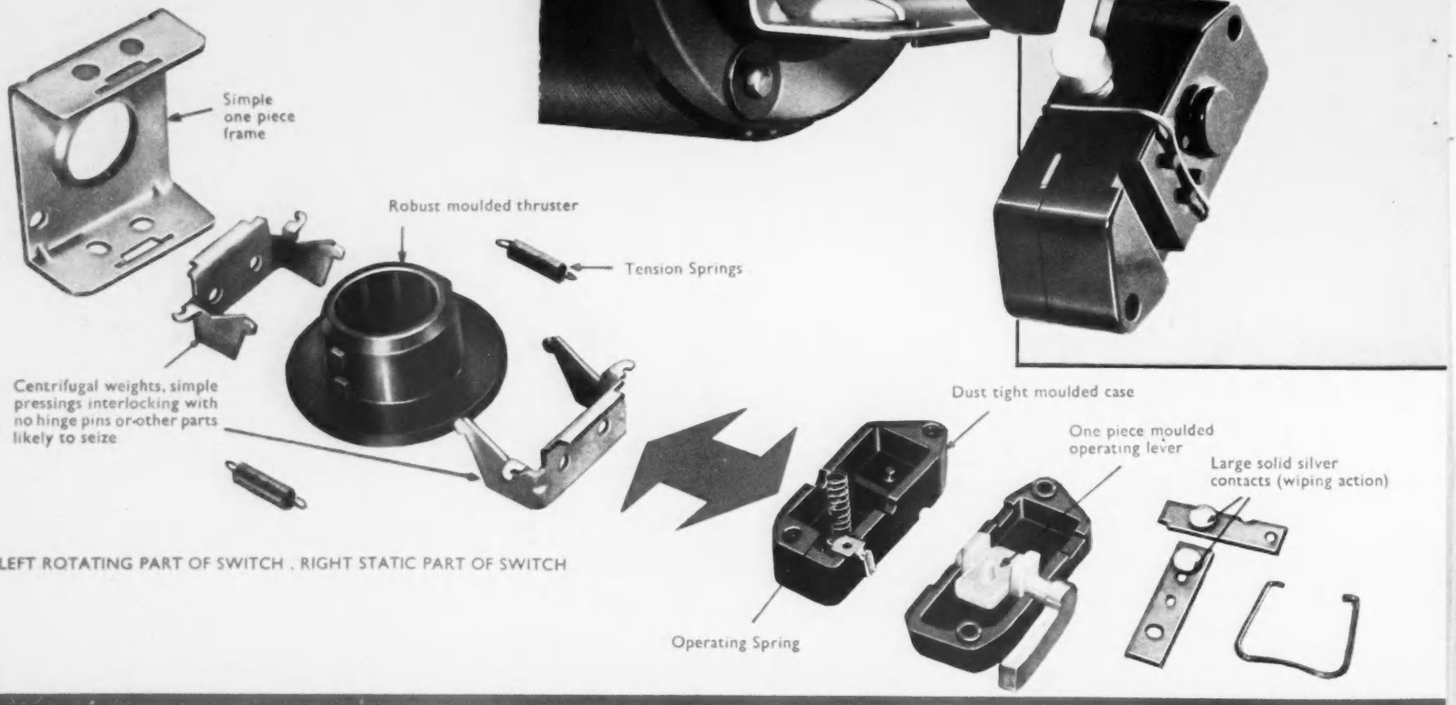
This is the centrifugal switch fitted in Newman 'BK' type industrial single phase motors. The rotating part consists of a very simple and reliable mechanism assembled from interlocking pressings which operate a moulded thruster arranged to slide along the shaft and engage the operating lever of a switch mounted on the inside of the non-drive end bracket. The switch itself has substantial solid silver contacts and is enclosed in a dust tight moulded case. When the motor attains about 70% full load speed at starting the centrifugal mechanism draws the thruster along the shaft and allows the switch which is spring loaded to open. There is no rubbing action or wear on the switch when the motor is running at normal speed. All metal components are rust proofed and the silver contacts are welded to the switch parts. The method of interlocking the components of the centrifugal device avoids the use of hinge pins likely to rust and seize. All components are easily replaceable. Contact pressure is controlled by a separate spring inside the switch and is independent of the pressure exerted by the thruster—the latter coming to rest against a stop on the shaft in the closed position.



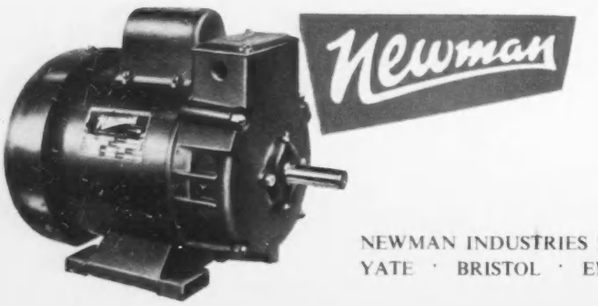
Reliability The life of a single-phase motor is largely dependent on the reliability of its centrifugal switch. The switch on a single-phase motor is required to function faultlessly every time the motor is switched on or off—disconnecting the auxiliary starting winding from the line as the motor runs up to speed and reconnecting it properly when the motor shuts down. Good switch design is vitally important. Failure in operation can lead to overheating and damage to either the starting or the main winding. The switch philosophy of Newman, who have had considerable experience in building single-phase motors, is:—absolute simplicity of design, robust construction and *continuous* research into methods and materials.

The centrifugal switch fitted in Newman type 'BK' industrial single-phase motors is typical of Newman design. The simple but exceptionally reliable mechanism of this switch is shown and described as an example of the "built-in" quality of Newman motors, giving longer life, unfailing power and greatest economy in operation.




Simple one piece frame
Robust moulded thruster
Tension Springs
Centrifugal weights, simple pressings interlocking with no hinge pins or other parts likely to seize
Dust tight moulded case
One piece moulded operating lever
Large solid silver contacts (wiping action)
Operating Spring

ON LEFT ROTATING PART OF SWITCH . RIGHT STATIC PART OF SWITCH



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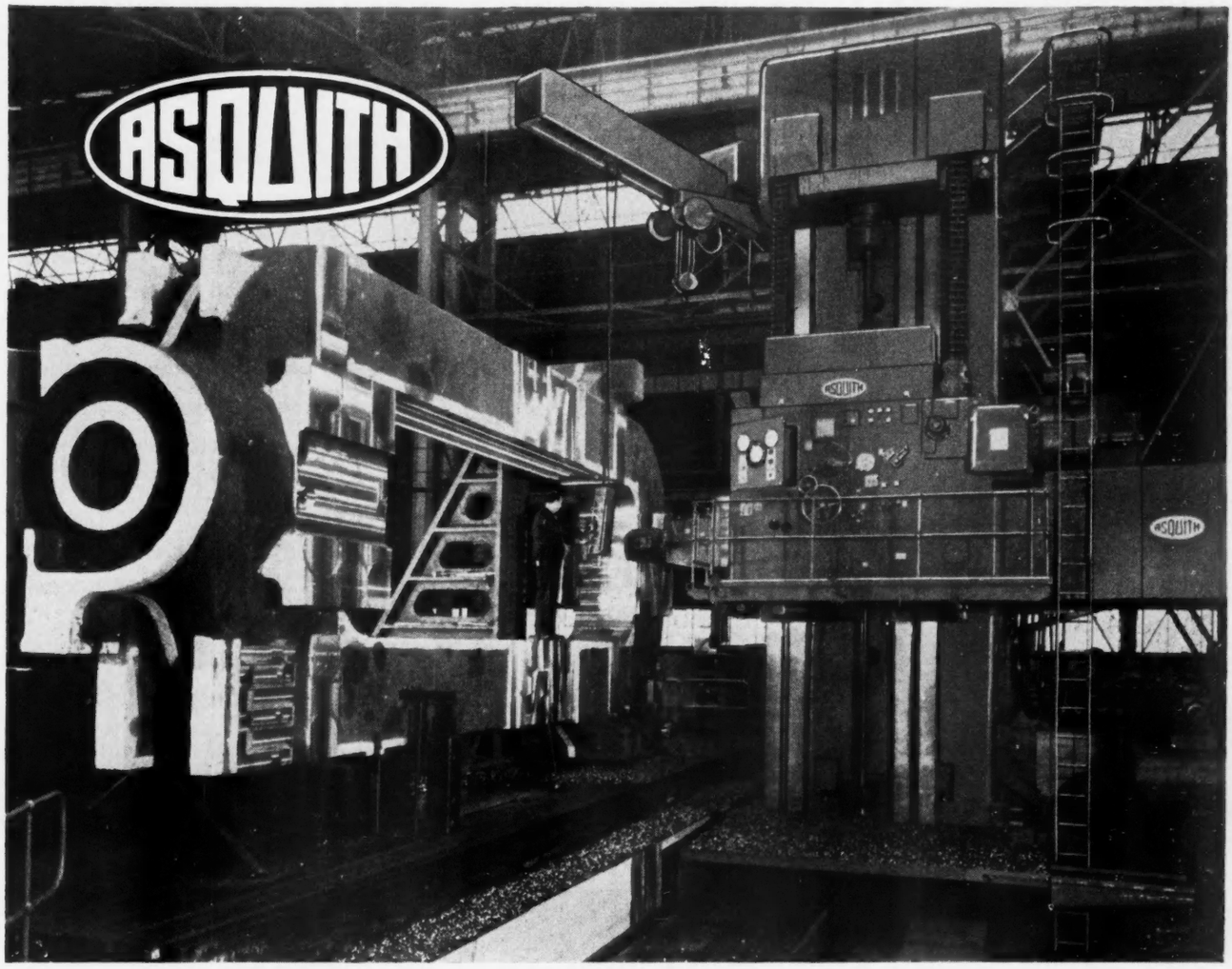

RAM TYPE *Horizontal Milling & Boring Machine at* DAVY-UNITED

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The exceptionally robust proportion of this Asquith machine can be appreciated from the illustration. A 28 in. by 36 in. ram houses the milling sleeve and spindle, both of which travel with the ram. The milling sleeve which carries the cutter is 23 in. dia. and attachments for right angle milling, etc., are of adequate proportions for heavy duty work. Surfacing slides are available and when fitted obtain feed and hand adjustments from the slide of the machine, thus having all the features of built-in facing heads.

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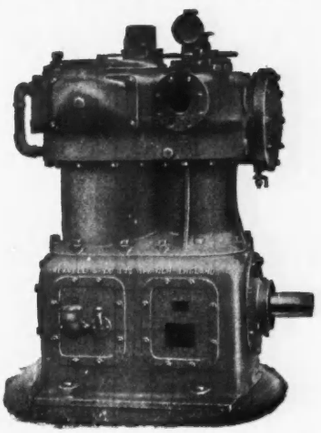

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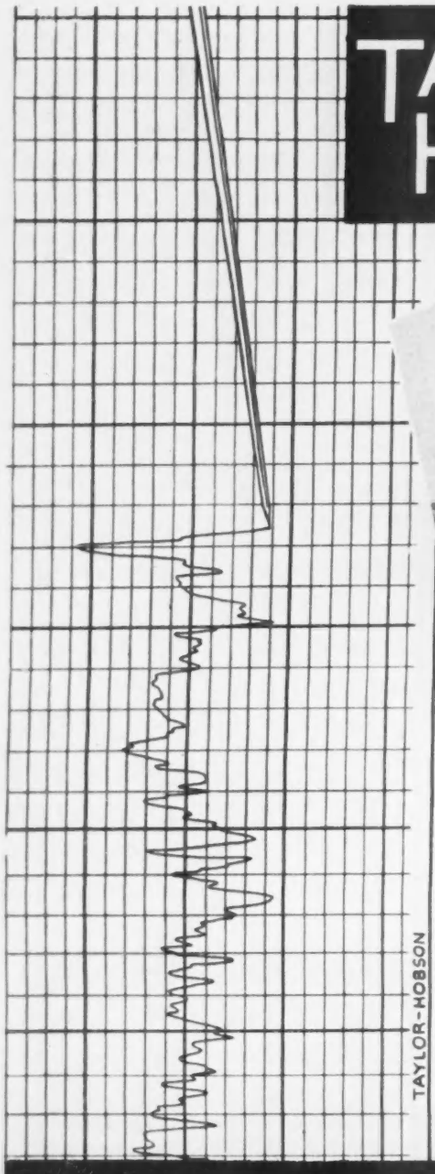

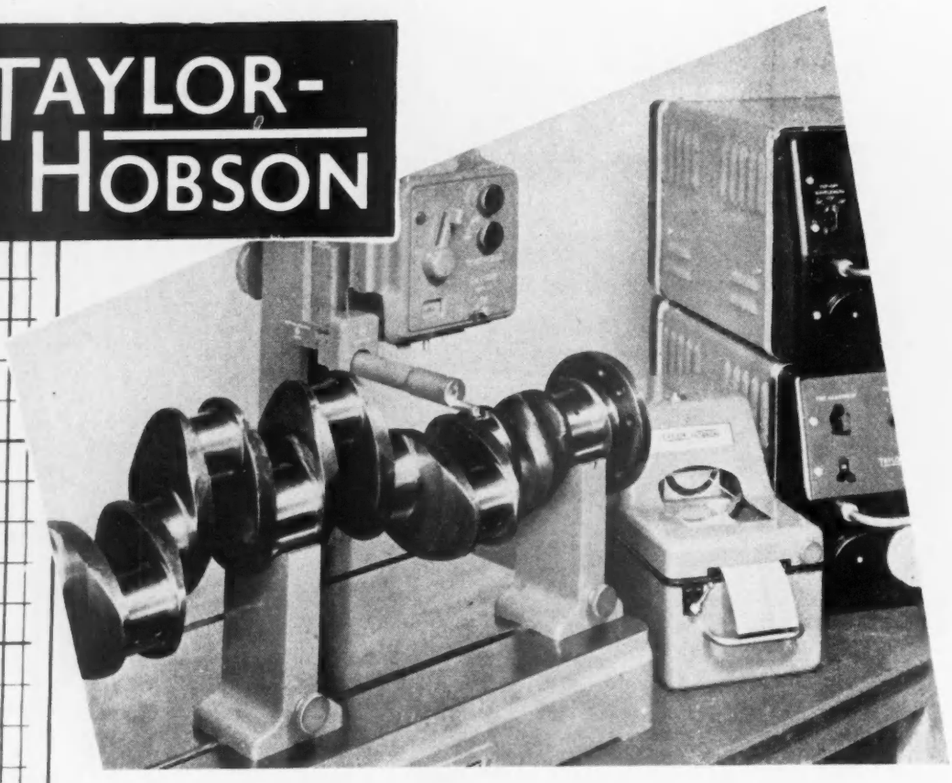

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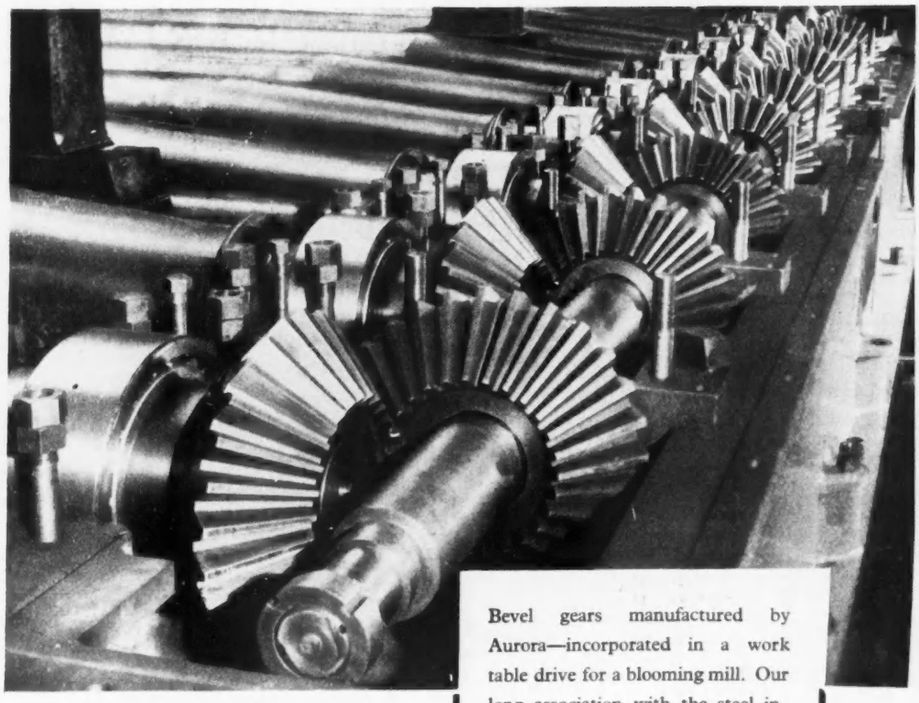

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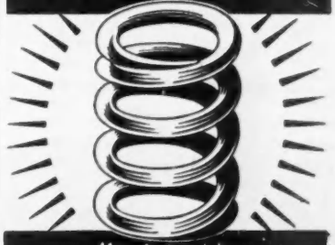

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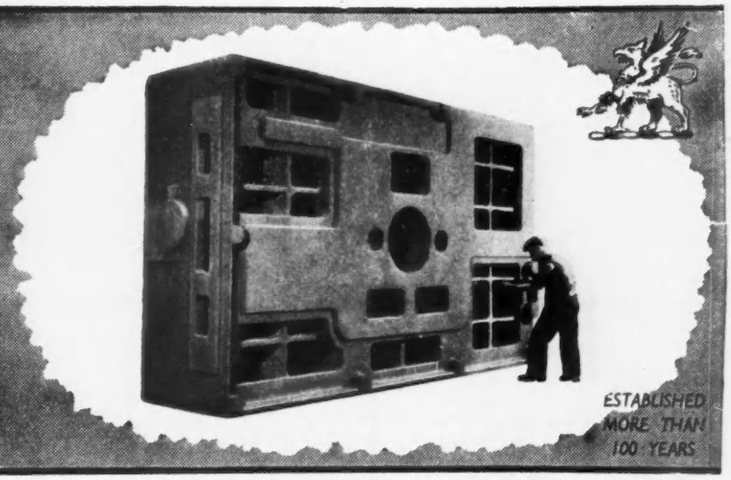

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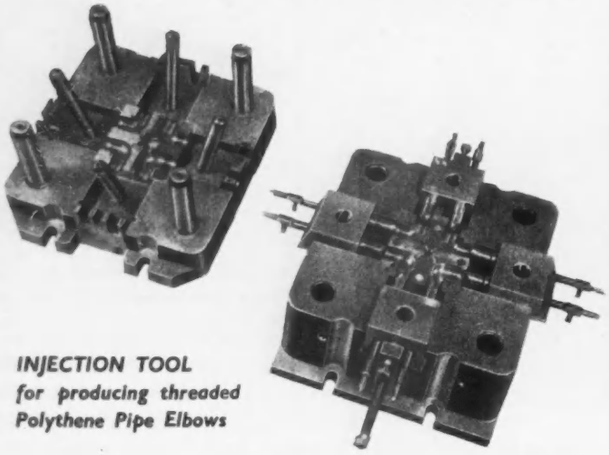

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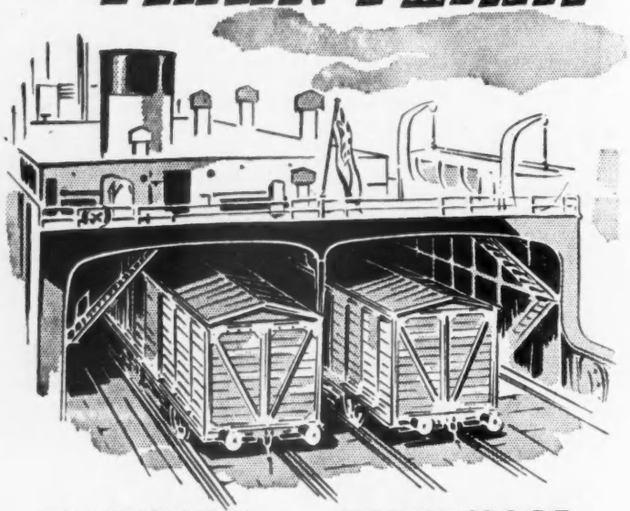

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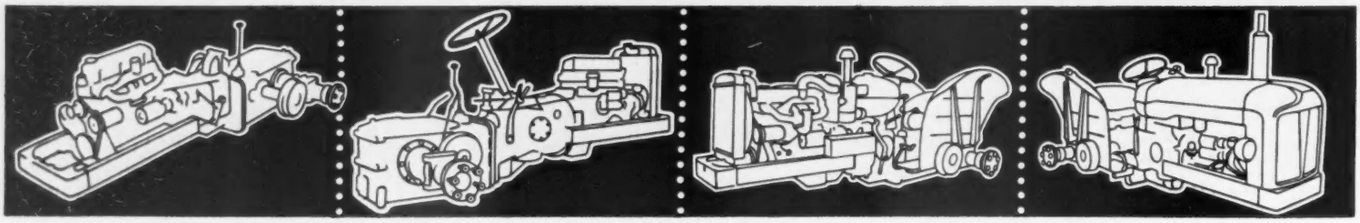

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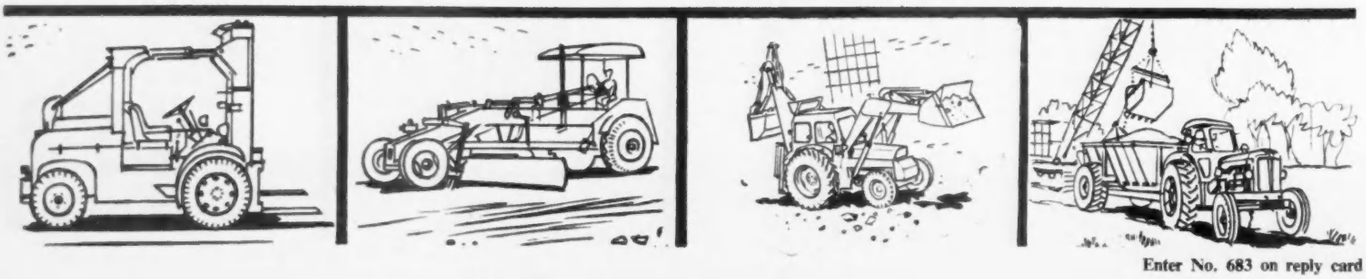

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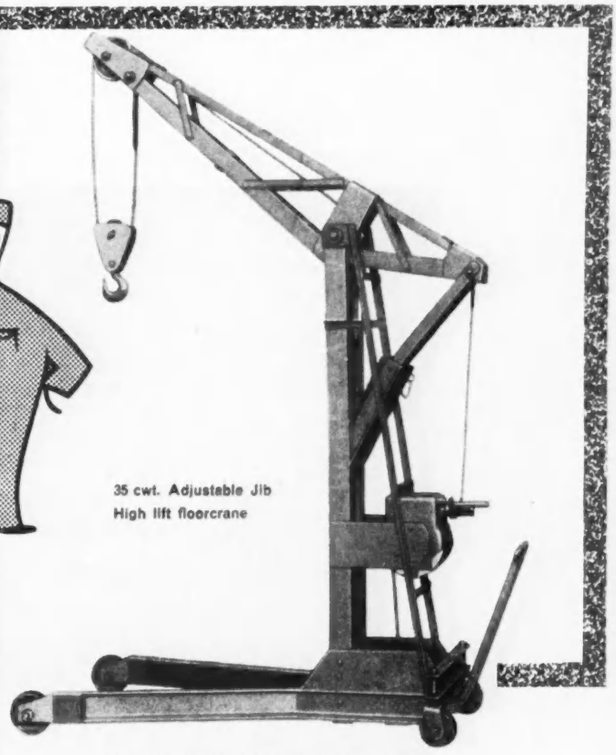

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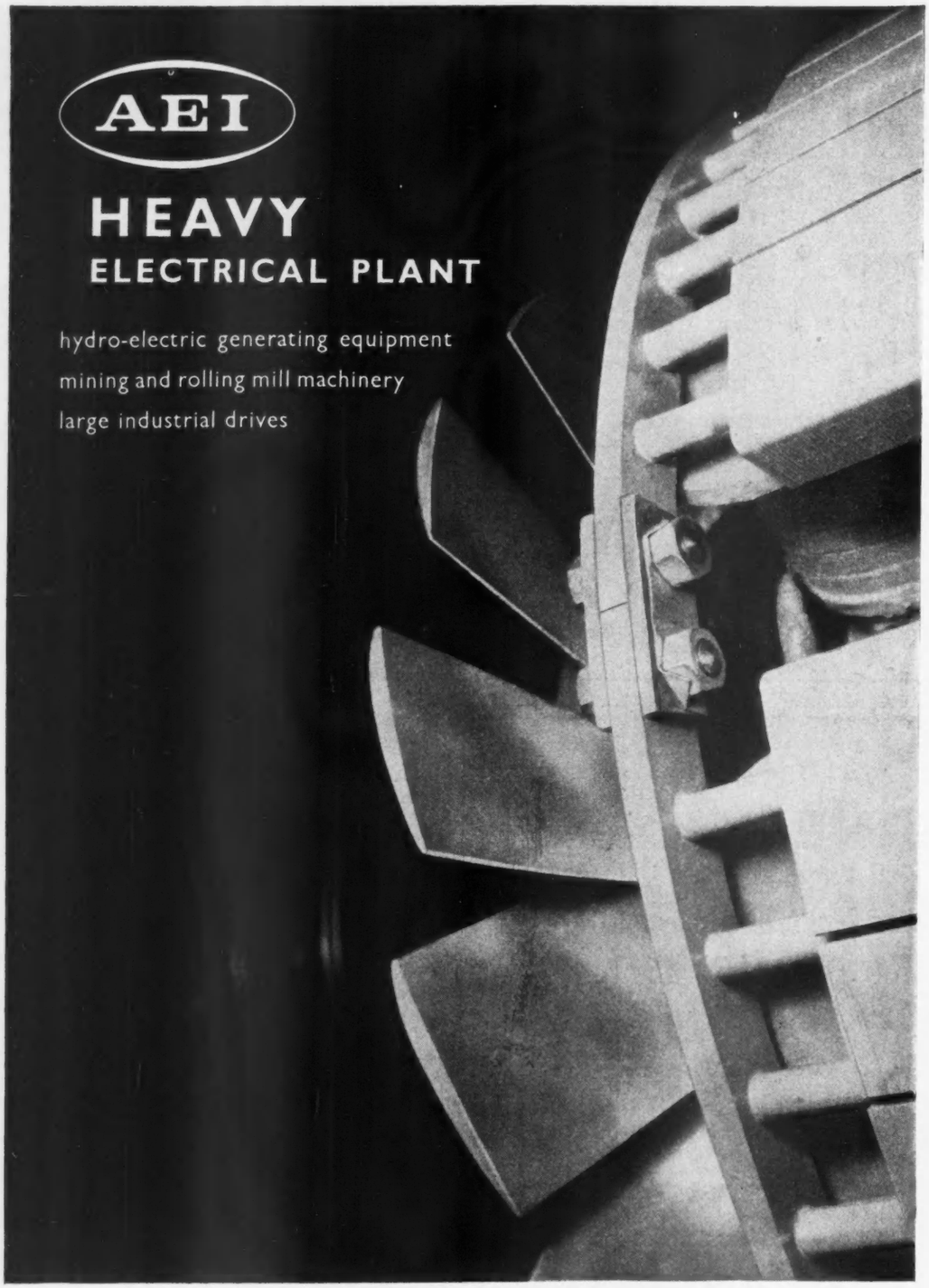

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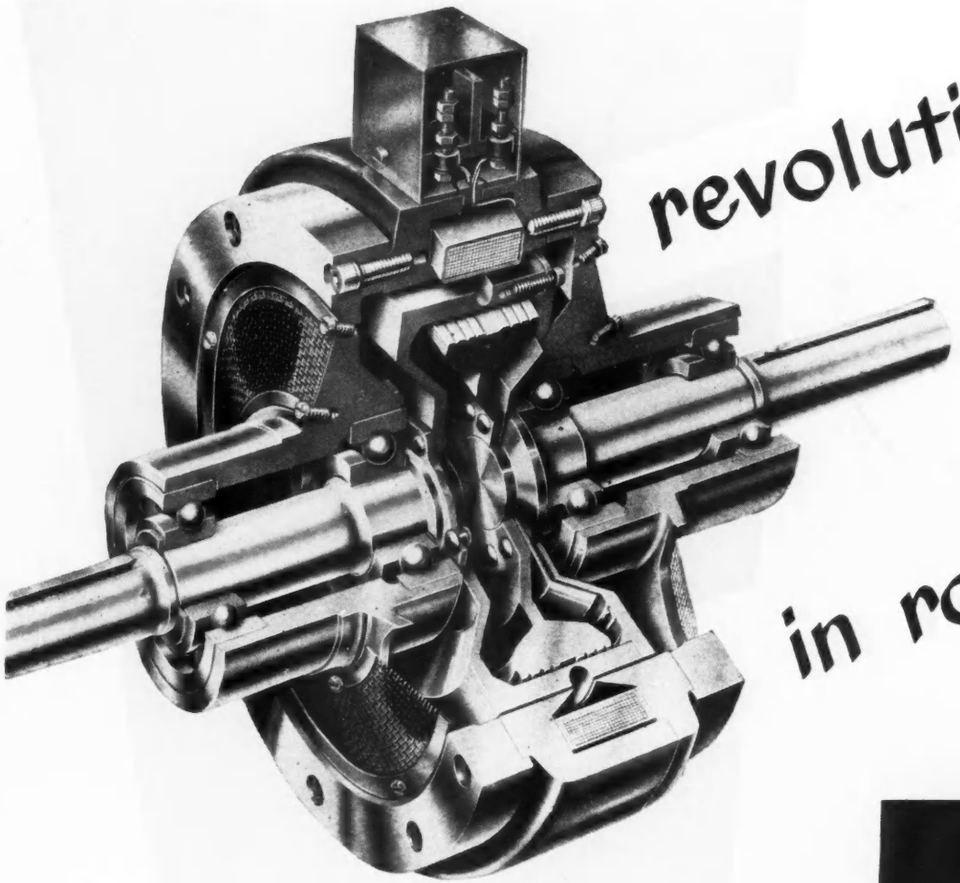

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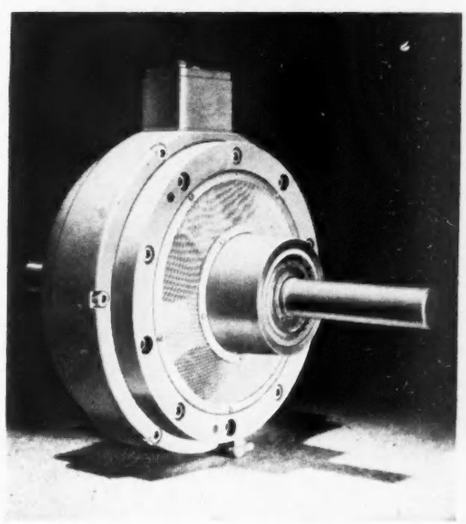

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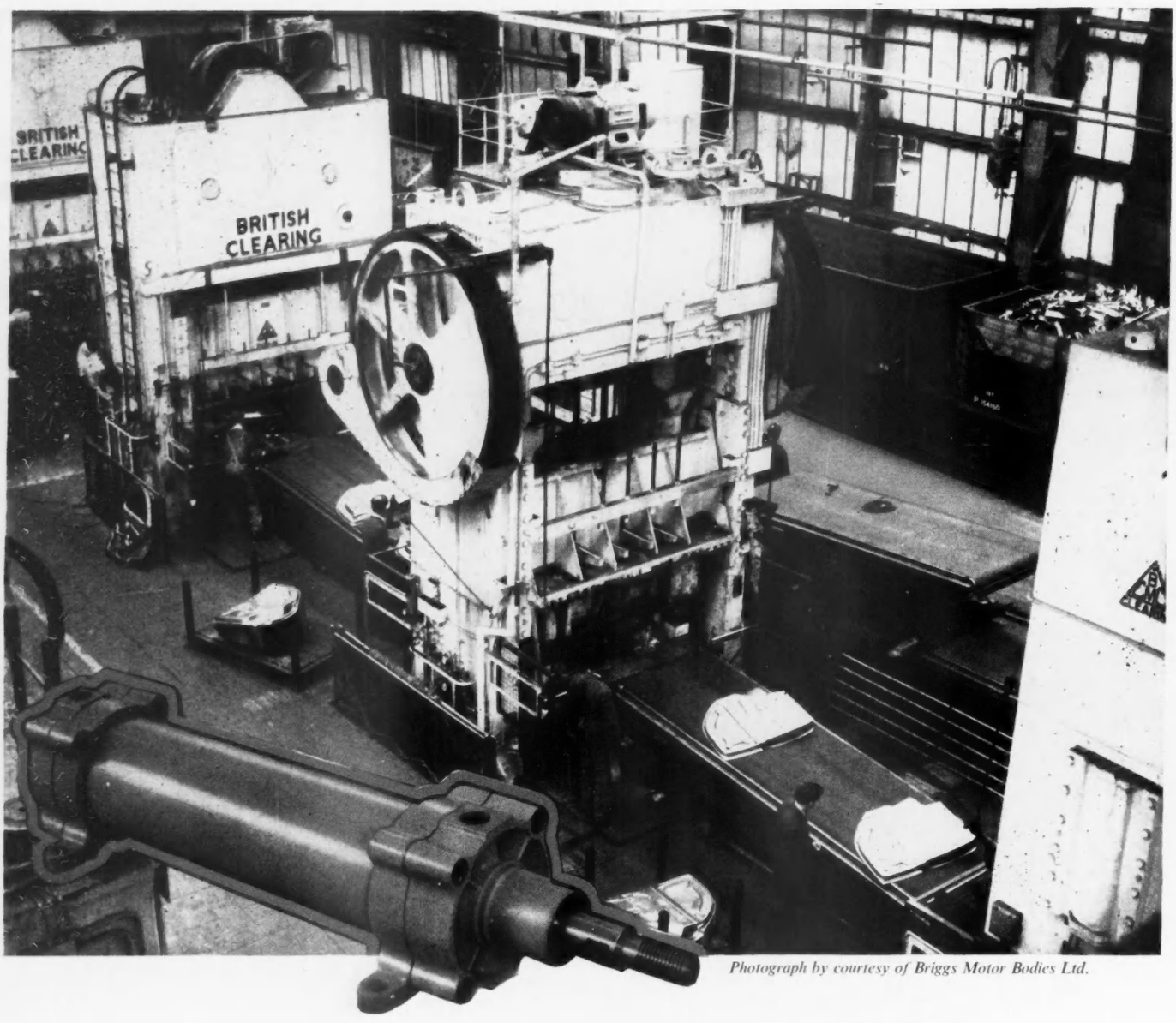

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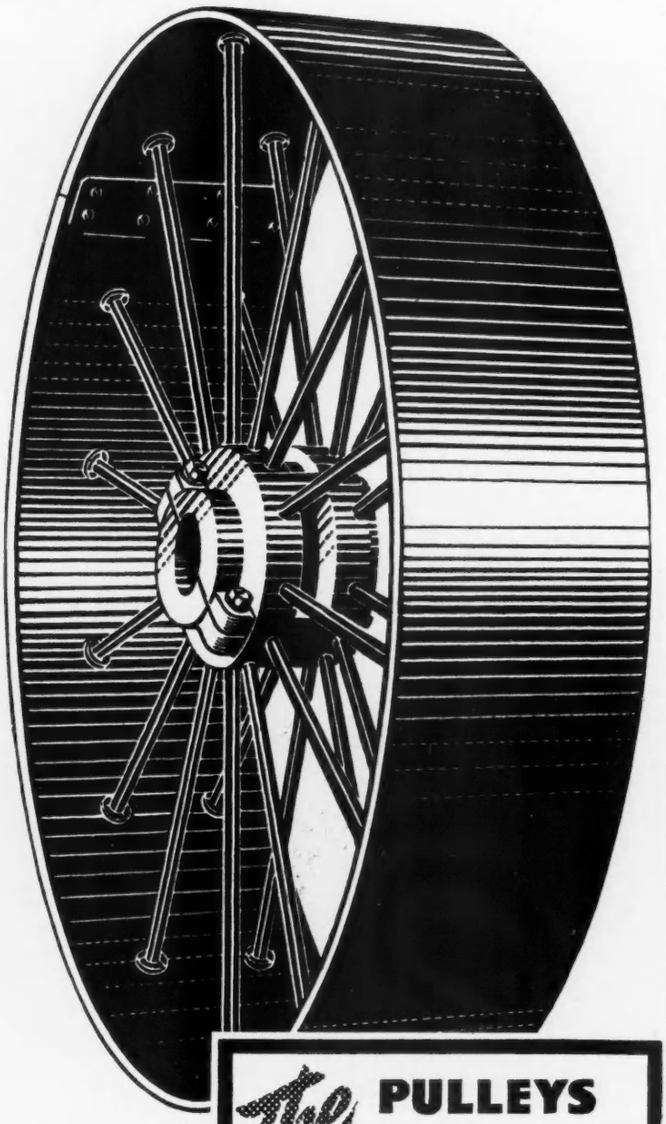

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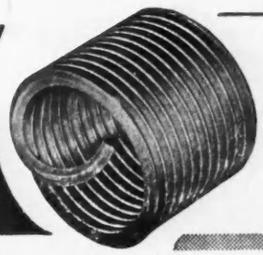

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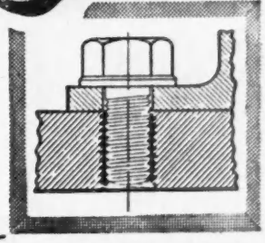

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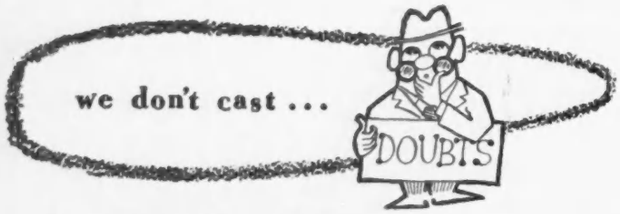

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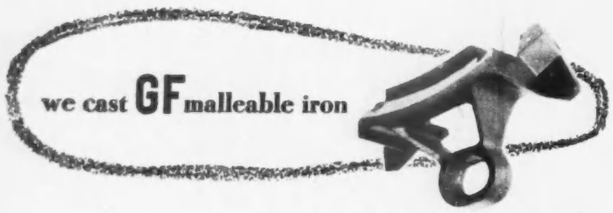

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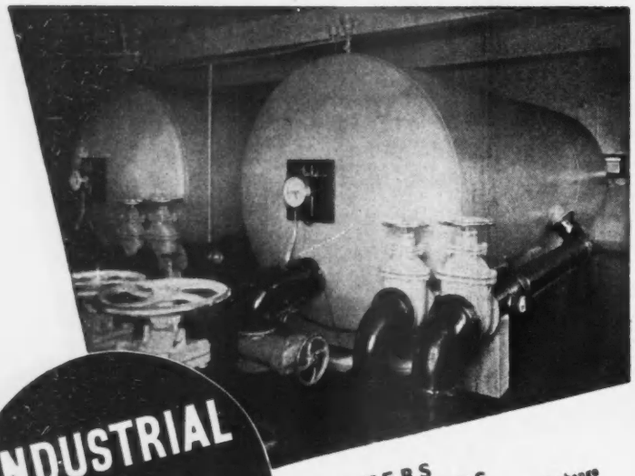

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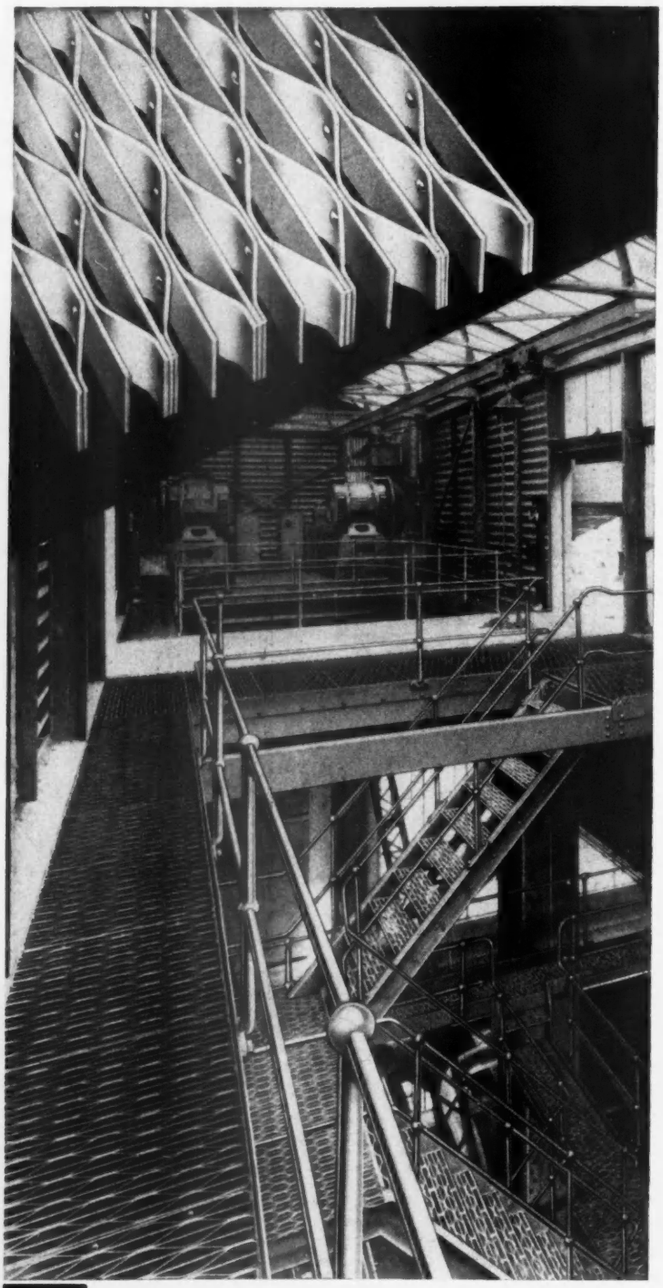

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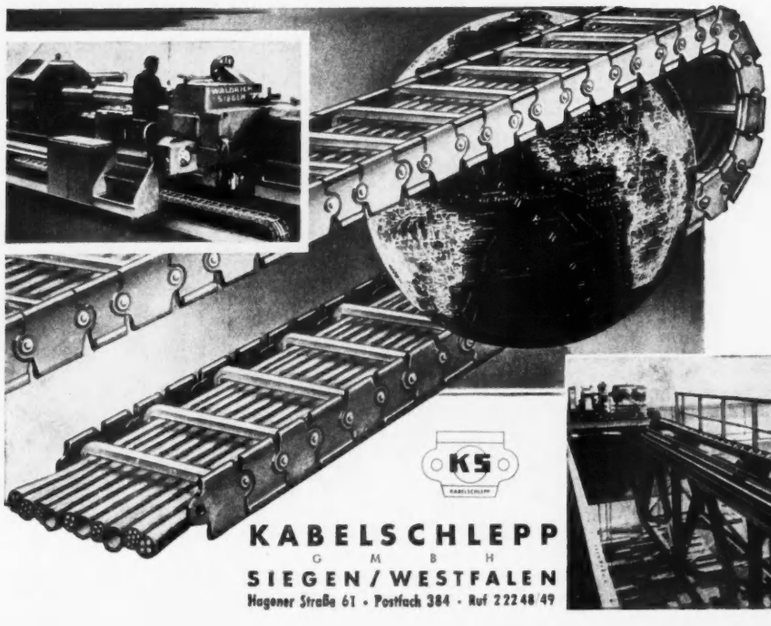

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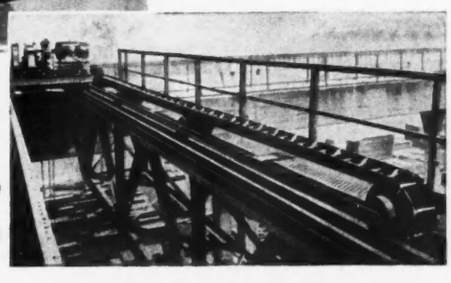

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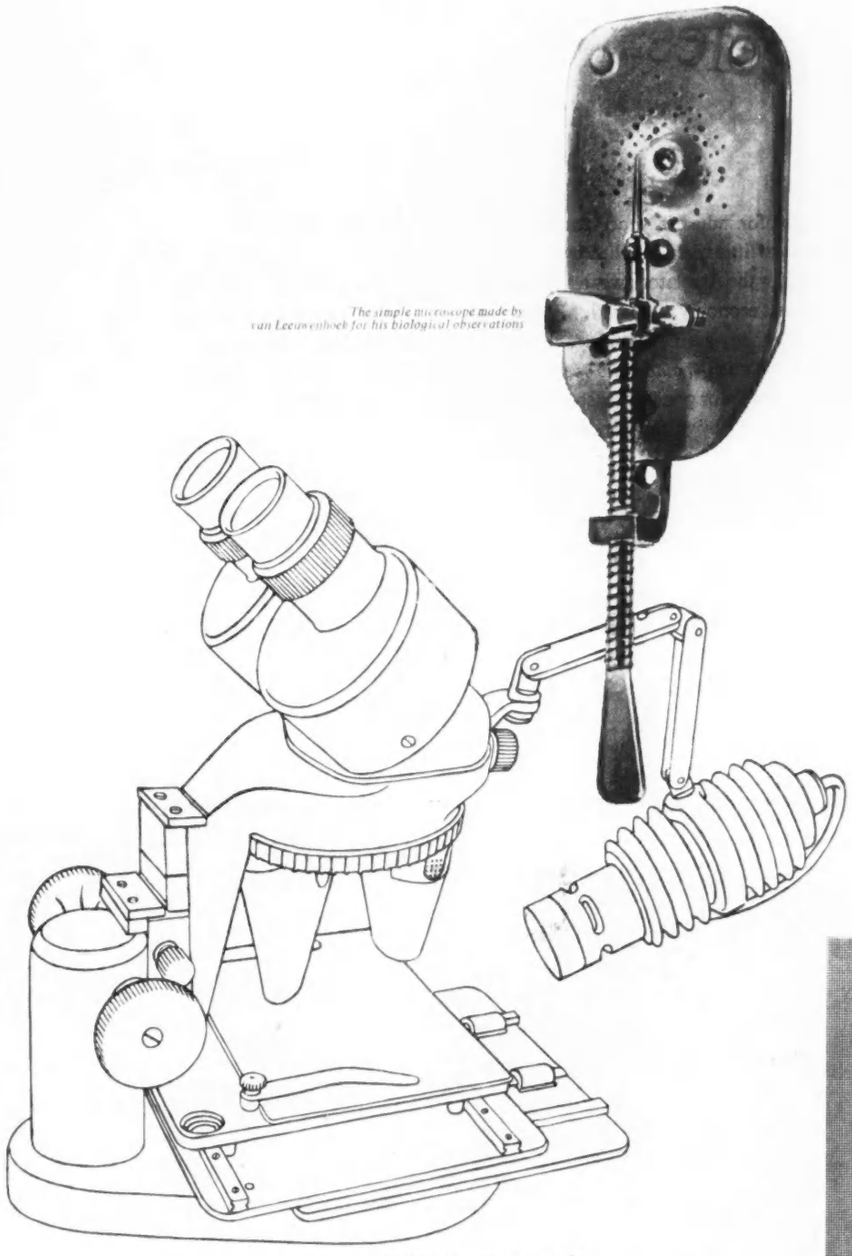

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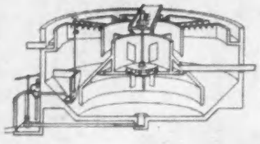

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THE ENGINEER

No. 5414 OCTOBER 30, 1959 VOL. 208

THE QUEEN'S SPEECH

A number of matters of interest to engineers were mentioned in the Queen's Speech at the opening of Parliament last Tuesday ; but only one was of anything like major importance. That was a reference to the introduction of the Bill to replace the Distribution of Industry Acts. Its purpose will be to provide enlarged powers to deal with local pockets of unemployment. As we go to press the Bill is being introduced into the House and we therefore reserve further comment until next week, when we shall be aware of its detailed provisions. Amongst other matters deserving notice there is the renewal of a promise made in the last Parliament that a Bill to change the law relating to charitable trusts will be introduced. The engineering institutions may well be interested in its provisions. Quite a number of firms are already paying wages by cheque, even though under the Truck Acts it is, strictly, illegal to do so. A Bill is to be introduced to legalise that method provided the employee asks that payment be made in that way. Another Bill relating to the licensing of air services is likely to prove of great interest to independent air lines ; possibly it will promise them greater freedom to run services, almost certainly it will seek to ensure that operators maintain standards of safety even higher than those at present ruling. Various other matters of interest are best revealed by quotations from the speech. The Government " will seek to develop the material resources on which the standard of living of the peoples of the Commonwealth must depend . . . The Commonwealth Education Conference which met last July made a number of recommendations designed to spread the benefits of education more widely within the Commonwealth. The consequential legislation will be laid before you. My Government will press forward with their plans to improve school buildings and to enlarge opportunities in the schools, technical colleges, and universities. More teachers will be trained . . . The improvement of conditions of life in the less developed countries of the world will remain an urgent concern . . . . . "

MINISTERS AND MINISTRIES

We are not politicians ; so we do not intend to comment upon the recent changes made in his Cabinet by Mr. Macmillan beyond referring to ministries which are particularly concerned with some facet of engineering. The Ministry of Supply disappears. No one will be especially surprised ; few, we think, will be particularly sorry, not even the personnel of that erstwhile Ministry. For it got more kicks than ha'pence and not infrequently took the blame when it was not in reality at fault, but was, in effect, shielding another ministry. The Ministry of Transport and Civil Aviation is split in two. The conjunction of those two titles in one ministry seemed right enough at one time because after all civil aviation is a form of transport. But, no doubt, the big schemes of rail and road reconstruction in progress require the less divided attention of a minister ; not, however, too undivided ; for the new minister gets the job of looking after shipbuilding and ship-repairing interests which formerly and rather illogically were placed under the Admiralty. Mr. Marples takes on this Ministry. Dare we hope he will prove even more energetic than was Mr. Watkinson in pressing upon the Cabinet the need for new roads everywhere and especially in urban areas ? The new Minister for Aviation is Mr. Sandys who will have to struggle with the somewhat intractable problems of an aircraft industry moving into a new age when the development of civil aircraft will have to proceed with less assistance from research on military machines. The Ministry of Power is to be demoted now that Lord Mills is to leave it and will no longer carry its minister into the Cabinet. Lord Mills, however, is still in the Cabinet as Paymaster-General and there available to give advice on industrial problems.

By far the most interesting appointment is that of Lord Hailsham to be Lord Privy Seal with the general task of promoting scientific and technological development. He will have ministerial responsibility for the work of the Atomic Energy Authority, the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council, the Overseas Research Council, and the Nature Conservancy. Work on space research, too, will, it seems, come under his supervision. There is to be, it will be observed, no actual Ministry of Science. Nor does there appear to be any intention of moving any scientific staff away from existing ministries. Lord Hailsham's job has been described as the promotion of science in the civilian field and according to a statement of his own " that will mean a certain amount of fundamental thinking about the relationship between the Government and science." It is certainly encouraging to find science represented at Cabinet level in the Government. But we are left feeling still very uncertain what Lord Hailsham's job will really turn out to be. Perhaps he is a little uncertain, too ! For his job may well turn out to be largely educational—educating Cabinet and other ministers to value the scientific approach and educating scientists to see problems nationally and internationally. Lord Hailsham certainly considers that science is at present inclined to be too parochially minded and that each of the councils for which he becomes responsible tends too much to concentrate on its own affairs. Similarly, those concerned in each of the many branches of science often tend to be blind to the value of other branches. Lord Hailsham may be able to encourage broader thinking all round. But we are left with certain qualms. He seems so much to stress the development of science rather than its application ; and he is clearly very dependent upon the Advisory Council on Scientific Policy, on which technology is not very fully represented, for guidance. In this country, we tend, surely, rather to

over-estimate the value of scientists as against technologists. Their interests do not always coincide exactly. We hope Lord Hailsham will hold a just balance while acting as the spokesman within the Cabinet.

TREATING LONDON'S SEWAGE

Apart from its great size, there are several notable features in the new treatment works inaugurated by the Duke of Edinburgh at the London County Council's northern outfall at Beckton. In fact, the new works (i.e. the two sections completed in 1955 and last week respectively) may well be regarded as a model of contemporary practice in this field. Points which call for comment include the large-scale use of gas turbines in the power station, probably for the first time, surprisingly enough, in sewage works practice. The sludge digestion plant is large enough to digest all the sludge produced at the works with a short retention period, and the secondary digestion is then carried out in the open, without gas collection, which is considered uneconomic in the secondary stage. The primary sedimentation tanks completed in 1955 have proved in practice to give a good performance for a short retention period, the normal criterion of allowing capacity of three times the dry weather flow not being used here. And the diffused air plant, although largely conventional, is a fine plant of its kind ; the operating gallery is a novel feature, and the constructional methods were also noteworthy. These new works—for primary and secondary treatment and sludge digestion—have altogether cost the L.C.C. over £9,000,000 to construct. In broad terms, all the sewage at the northern outfall will now get primary sedimentation and about two-thirds secondary treatment on the activated sludge system. Thus, very approximately one-third of the sedimented sewage will still be discharged directly to the river, remembering that the exact " capacity " of the new secondary treatment plant needs to be ascertained from actual operational experience. At the L.C.C.'s Southern Outfall at Crossness, a large scheme is also in progress, at an estimated cost of about £10,000,000. This will be completed in 1963 and it will give primary and secondary treatment (in this case by a surface æration method) to the entire flow.

With both these works complete, the effect on the Thames will, without doubt, be very marked. Can it be considered that at this stage, after the expenditure of around £20,000,000, the L.C.C. will have done enough ? The answer must surely be that, to complete a job undertaken, so far, in a very commendable manner, the extensions envisaged in primary and secondary treatment at the Northern Outfall should be built. The whole of the London area would then be producing in the Thames at Barking and Crossness, what is commonly though oddly termed a " Royal Commission " effluent. Purification of the tidal estuaries of the country's large rivers, like the Thames, is a crying national need. Standards accepted now are almost universally very poor. To think of the lower Thames as an industrial river, not in need of purification, is to be fifty years behind the times. Thus, in complimenting the London County Council on the completion of a noteworthy feat of civil engineering—apparently the largest single project it has ever undertaken —we would suggest that the Council should continue to maintain a lead in this important matter by pressing on with the ultimate stages of the plan. Its example may encourage local authorities elsewhere to undertake similar expenditure upon the cleaning-up of other even more filthy estuaries.

COMPETITIVE DESIGN FOR ROAD BRIDGES

Don Quixote's extravagant behaviour in tilting at windmills has been matched in our midst, by a humble contractor who has tilted at the Ministry of Transport. The events prior to the Ministry's acceptance of the tender for the Bell Weir bridge at Staines were outlined in last week's issue of THE ENGINEER. It is possible to have sympathy for some of the arguments on both sides of the dispute, and it is not our intention to support either side in this particular case ; the reader may assess the facts for himself. Furthermore, construction of the bridge has already started, so clearly the two parties will have to agree to differ ! There is, however, a wider issue, an issue of principle, which is well worth discussing, and which should be elucidated on a rational basis since the country is at the beginning of a large programme of construction for roads and bridges. We refer to the inclusion of design within the sphere of competitive pricing for contracts for civil engineering works, and here particularly, for bridge works.

The usual practice is well known. The consulting engineer prepares his design, in detail, and the contractor submits a tender based on it. What the Ministry of Transport has been challenged to do, is to consider alternative bids based on a contractor's own design. The advantages accruing are considered to be the full integration of all aspects of design and construction, with consequent economy in cost and construction time. The main disadvantage is, likewise, considered to be an inroad into the independent status of the consulting engineer, this status being equated to a guarantee of sound design. Presumably for this reason, the practice of competitive designs is quite rare in this country, though comparatively common on the Continent. There are, of course, only certain kinds of schemes where it can be applied, but road bridges would appear to be judged to be ideal schemes by its exponents. An example —apparently very successful—of this type of approach was the construction some years ago of the maintenance base for B.E.A. at London Airport.

There is probably little if anything to choose between having a first class consultant design a job in the normal British way, and asking for alternative designs from contractors. We think, quite strongly (and here we emphasise that we are speaking in general terms and not referring to a particular case) that a good consulting firm has nothing to fear from competitive design, but undue conservatism in design would undoubtedly be discouraged. There are other aspects of the problem of tendering too ; three eminent views on this topic were quoted in a leading article in our issue of November 29, 1957, and to save repetition here, we would refer the interested reader to them. In spite of the importance of this topic to the engineering industry, as a whole, this leader attracted only one letter, and that from an Australian correspondent. The fact that this old controversy has once again been thrust in the public eye at this moment has a certain special significance. A new Minister of Transport, Mr. Marples, has just taken office. We recall an occasion some years ago when Mr. Marples addressed the Association of Consulting Engineers, and urged that, to make constructional work more competitive, design should be brought within the sphere of competition. We rather gathered the impression that the Association did not agree with him. On his taking office we find his Ministry, equally enthusiastically, has just done its best to be dissociated from this practice ! The Ministry has suffered some heavy criticism in this matter. It is not a saving of, say, 10 or 20 per cent

in the cost of a bridge which is claimed, but in one comparison, with a German "flyover," it is claimed that the cost is equivalent to only one-third of that prevailing here, for a similar structure. The new Minister, Mr. Marples, will have a hard task to live up to his predecessor's work. Nevertheless, he has a background in the civil engineering world which gives us grounds for hoping that he will be a worthy successor and will carry on Mr. Watkinson's task, by expanding the road programme yet again to a scale commensurate with the estimates made at the Institution of Civil Engineers "Highway Needs" conference, and also removing any grounds for criticism that the Ministry of Transport lags behind the times in its methods or its technical appreciation of design and construction.

EXHIBITION FACILITIES

Until about two years ago there was quite an amount of talk in this country about the building, somewhere not too far from the centre of London (or possibly elsewhere), of a group of large modern exhibition halls in which national or international exhibitions similar to those held at, for example, Hanover, in Germany, could be put on and British Industry, with a capital "I," could be put on show. But those grandiose ideas were found two years ago to be just what British industry did not want! An authoritative inquiry conducted by the Federation of British Industries in 1957 found that the vast majority of people in industry generally, not merely in engineering alone, favoured specialised exhibitions. The fall in the prestige of the British Industries Fair, leading to its eventual demise, demonstrated the same point. For even had a grander setting been available for it, we suspect it would have suffered the same fate.

The Federation's conclusion cleared the air. For it meant that there could now be no question of the Government or any other body supporting grandiose schemes for the erection of groups of great exhibition halls. However, as we ourselves pointed out at the time, the rejection of the grander plans only made it the more necessary to consider what kind of accommodation was needed to meet industry's preference for specialised and sectional shows. Having, of course, the engineering industries especially in mind, we expressed the opinion that at least one new hall needed to be built which would be capable of accommodating really heavy exhibits. That hall we also felt, should be as near as possible to the centre of London. Those opinions have now received the weighty support of an F.B.I. Committee which has been examining exhibition facilities in this country. That committee, in its report, comes to the conclusions that the halls at Olympia and Earls Court, at which all the major exhibitions are now held, are individually and jointly inadequate; that "the provision of a new and worthy exhibition centre for London is a matter of national and not merely commercial importance"; that it should provide at least 500,000 square feet of net exhibition space on the ground floor, where heavy loading can be carried, and provide on upper floors administrative offices, restaurants, conference rooms, &c.; and that around the building there should be ample space for unloading yards, car parks, &c. Further, it concludes that the building should be as near central London as may be, and suggests the site should be in North Kensington or West Kensington, that is, not far from the existing halls at Olympia and Earls Court; and that the finding of a suitable site and its development might be combined with "one of the many road improvement schemes so badly needed in Central London" and with "a private developer's scheme for a new hotel." These conclusions —and the additional one that there should be Governmental assistance financially on the ground, amongst others, that "the development of a first-class modern exhibition centre in London" would be of "incalculable" prestige value and "bring many indirect and invisible benefits to the nation as a whole"—are based upon a quite exhaustive analysis of the existing situation, including a study of the advantages and disadvantages of the Crystal Palace site and the desires of many industrial associations.

We can find little in the report that will surprise anyone who has talked to an exhibition organiser, taken space at an exhibition, or seen how quite small towns abroad, such, for example, as Liège, have put up substantial exhibition buildings, including conference halls equipped for continuous translating and having full catering facilities. Taking into account the advent of the Common Market on the Continent and even more particularly the possible emergence of a Free Trade Area of seven countries of which London may well act as the trade and commercial centre, it seems to us to be a matter of some urgency that a suitable site should be acquired and work be actually started in the very near future.

The Engineer—100 Years Ago (OCTOBER 28, 1859)

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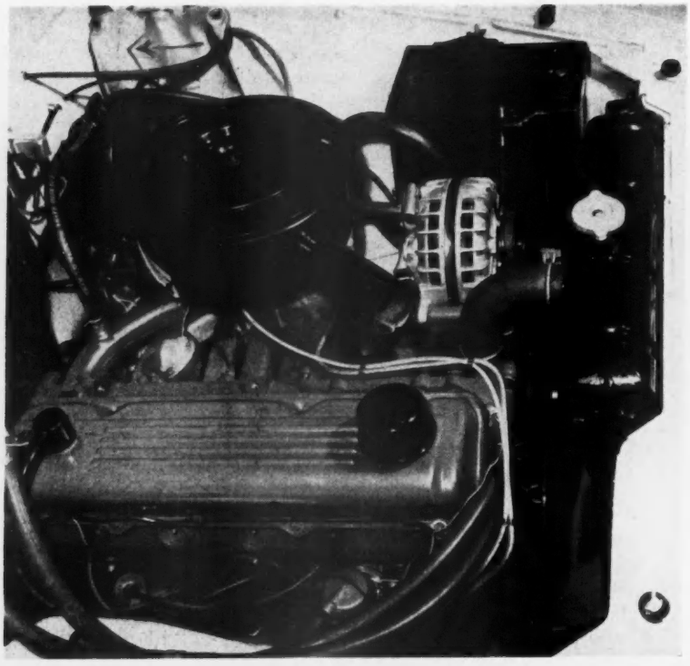
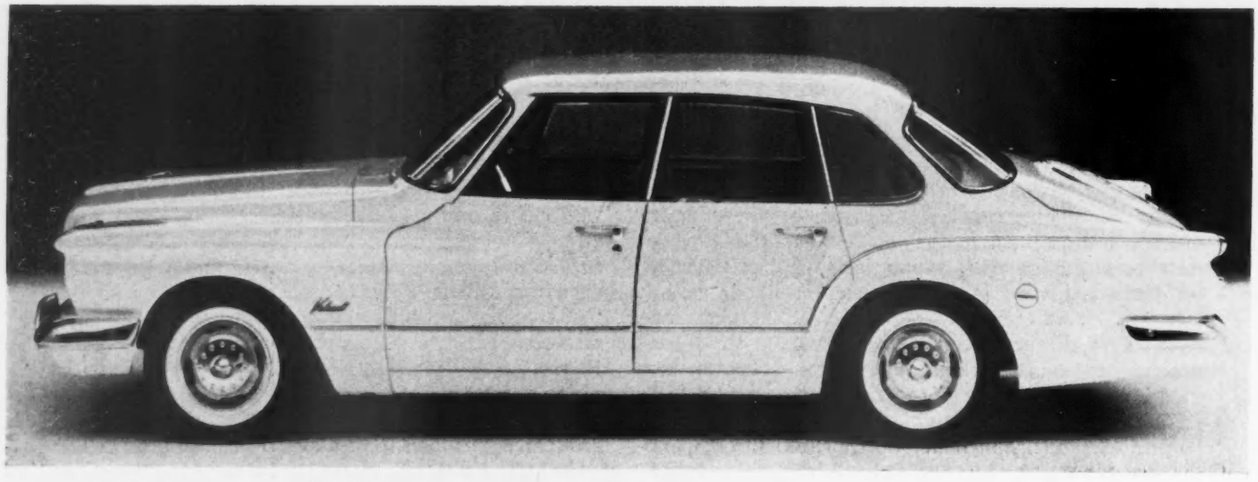
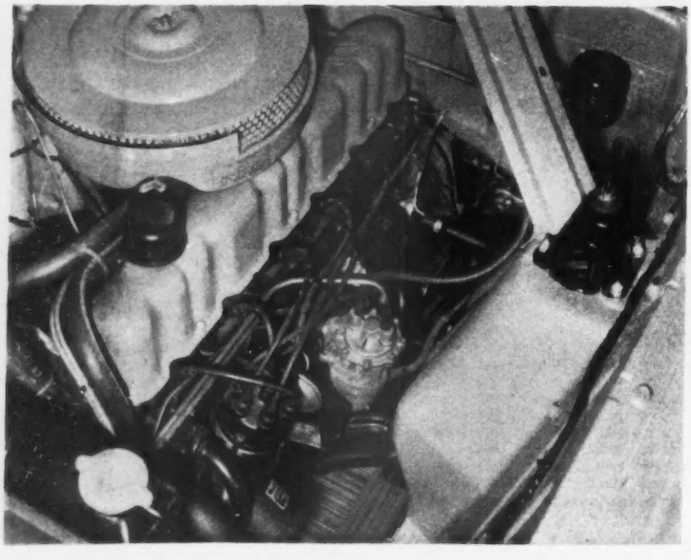
"The permanent way appears to be the principal matter in which radical improvement is necessary. As now made, its parts are in a state of general disturbance under passing trains, and it is out of that disturbance that most, if not all the concussionary resistances arise . . . Until we secure absolutely firm foundations for our railways it will be useless to seek strength by laying ingeniously contrived rails, cast-iron bed-plates, or stone blocks upon a loose yielding soil. The stone blocks come the nearest, in their amount of bearing power, to piles, and had the former presented a continuous support, with an india-rubber or wooden bearing, for a light rail which would have been thus rendered inflexible, we are inclined to believe that the system would have been still in favour. As for india-rubber plates, properly confined under the rails, we have seen specimens which have remained perfectly sound after three years' hard service. A plate of iron, which, when laid upon an anvil, received an indentation $\frac{1}{4}$ of an inch deep from a punch struck with a certain force, was penetrated but about $\frac{1}{16}$in when subjected to the same blow whilst resting on an india-rubber plate. It is probable that with small rails, properly fastened, and having steel surfaces, their duration would be double the usual average; whilst at the same time they would, by the superior condition of their line and surface, admit of speeds approaching 100 miles an hour."

"Compact" Large Cars

All three of the compact cars built in the United States of America are 15ft long, and the two with engines at the front driving the rear wheels are 5ft 10in wide. The Plymouth "Valiant" has noticeably the largest engine, a 2·8 litre six, and since a single-bank design with overhead valve gear has been adopted, it has been necessary to install the engine asymmetrically, at an angle of 30 deg., to fit it under the bonnet. The coil and fuel pump are on the underside of the cylinder block, and the sparking plugs embedded deep in the cylinder head. RIGHT can be seen the machinery space : conspicuous is the alternator that allows the heavy drain of lights, heater and windscreen wipers to be met at low engine speeds ; six silicon diode rectifiers are mounted in the back of the cast light alloy casing. Beyond the air cleaner can be seen the vacuum brake booster, this fitting and hydraulic power steering being optional. Also available is automatic transmission as an alternative to a three-speed synchromesh box with remote control on the floor inboard of the driver. Rear suspension is Hotchkiss drive, so that the luggage boot is shallow : the spare wheel is actually under the removable boot floor, but a wheel-shaped bulge in the lid increases the available depth. There is also available an estate car, with four doors and two or three seats : the luggage space then increases from 25 cubic feet to 72 cubic feet.



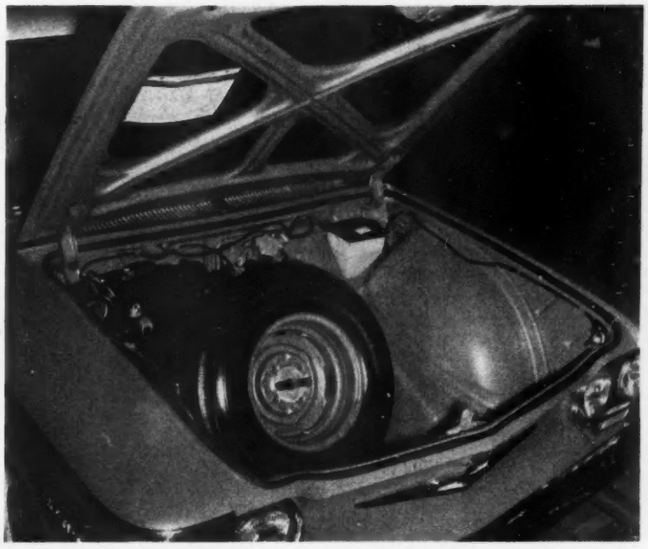


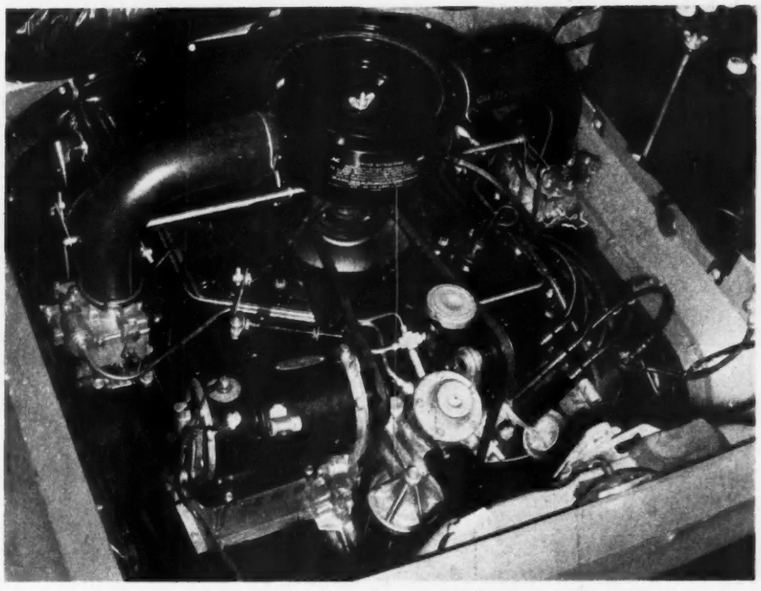


The Ford "Falcon" is a conventional car, although an appearance of spaciousness is attained by the use of windows of complex curvature. The suspension resembles that of the vans made in England, employing wishbones and ball joints, but the springs and telescopic dampers act on the top wishbone, so that the lower ball does not experience the heaviest loads both horizontally and vertically : hence, from under the bonnet the structure resembles that of a car with MacPherson suspension. The engine slightly surpasses that of the "Zephyr 6" Mk. I in capacity and Mk. II in output, yielding 90 h.p. at 4200 r.p.m. from 2360 c.c. The view LEFT under the backward-opening bonnet shows the large exhauster on top of the fuel pump to drive the windscreen wipers, and the structure diffusing the suspension loads. It is interesting that, at 2460 lb, the "Falcon" is about 300 lb lighter than a "Zodiac," and the final drive is 3·10 instead of 3·90, with 6·00–13 4-ply tyres instead of 6·40 (6-ply optional).

Another "Compact" Car

The smallest of the compact cars, the Chevrolet "Corvair," is 3in lower and less wide than the others, but is a six-seater without qualification To enclose a deep pit for luggage, the nose is made high and long : under the bonnet or hood can be seen the combustion heater. The translucent plastic container is for fluid for the windscreen washer seen immediately beyond the spare wheel. Like the "Valiant," this car uses the four-lamp system, in which the dipping elements have lenses designed solely for close range illumination, and the long-distance beams are provided by lights lit only with the main beam : all the elements have reference surfaces for mechanical setting of alignment.



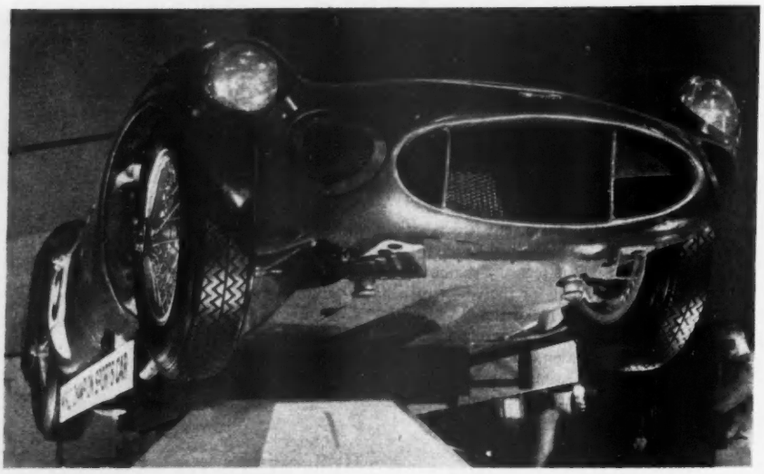


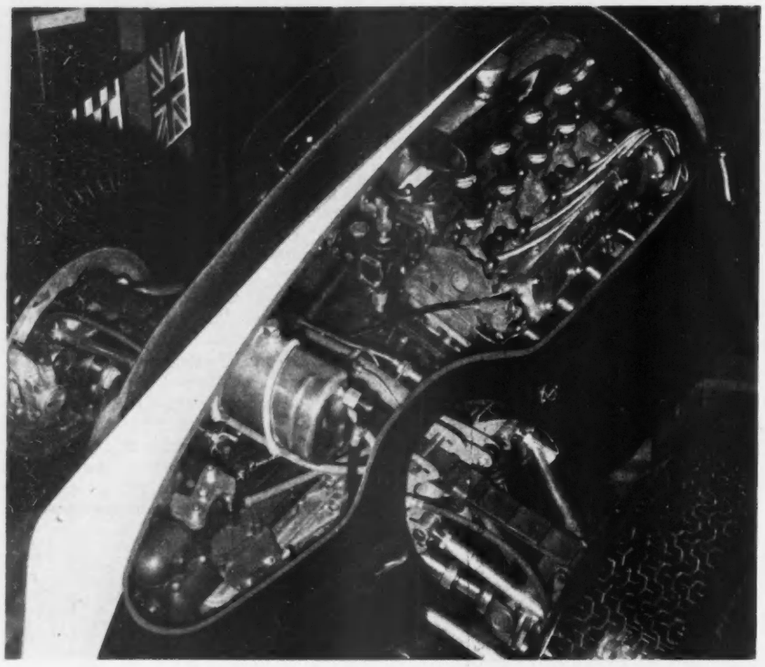
The engine bay of the "Corvair" is an eloquent reminder that the vertical engine gained acceptance when the removable cowlings were vertical. The illustration LEFT shows the ready accessibility of the twin carburetters and the more important ancillaries. The fan drive is an interesting example of power transmission by flexible belt, but the control of cooling is by a circular throttle in the impeller eye in the familiar European manner rather than by clutching the fan in and out on General Motors lines. The "Powerglide" hydrokinetic transmission is located in front of the final drive, under the large shelf behind the rear seats. The engine closely approaches that of the water-cooled "Velox" in both swept volume and output at the same peak speeds of 4400 r.p.m., but the rear-engine car has 3in more wheelbase and is no less than 6in lower.

This compactness is visible RIGHT where visitors are seen beside the car, in this case opening the door concealing the fuel filler cap. It can be seen that it is only in details that the car departs from orthodoxy : in fact, the front suspension is by wishbones with ball joints, although the wishbone axes depart from parallelism to suppress pitch under braking, and the rear suspension is by swing arms with axes skewed outward—the arms are folded up from sheet so that the drive shafts can enter them, the universal joints being exposed. Although the floor of the cabin is free from any obstructions, two shallow wells appear in front of the rear seat bench.

Racing and Record Cars

This year's exhibition included a number of cars that were not production models, but examples of engineering for the ultimate performance achievable within severe limitations. TOP is the winner of the 1959 Sports Car Championship of the World, an Aston Martin DBR1/300, the car illustrated being the winner of the twenty-four hour race at Le Mans. Details visible include the prominent guides to allow a racing jack to be rushed into position, and the feet of the built-in pneumatic jacks for simultaneous lifting of all four wheels. In front of the trailing arms of the front suspension can be seen the ducts carrying cooling air to the brake discs ; the small gauze-protected intakes are principally to cool the tyres.





It was recently announced that the most powerful Aston Martin, the DB-4 G.T., with 302 h.p. from its 3670 c.c. engine against 260 h.p. from the racing 2992 c.c. unit, both of which peak at 6000 r.p.m., has attained 100 m.p.h. from rest and returned to rest in twenty seconds : only five seconds was occupied by the deceleration, corresponding to an average of 0·95g, which, in view of the fact that the car is closed and of low-drag shape, explains the distinctive nature of the suspension, wheels and tyres.

The championship for Grand Prix cars was won by the Coventry Climax engined Cooper seen LEFT. The manufacturers of this vehicle specialise in racing cars with only secondary interest in sports cars, and the design is devoid of any compromise towards the methods familiar in heavy vehicles. The car is seen with the rear wheels located by rigid links, but the upper wishbones are adjustable to vary the camber and hence the static margin : similarly a selection of loading points for the spring allows the suspension and roll stiffnesses to be altered, and alternative suspension pivots give control of roll centre height. The ZF differential is driven through a selection of final drives and a four-speed gearbox from a two-plate or three-plate clutch. The 2490 c.c. engine has two twin-choke carburetters and is attributed with 236 h.p. at 6570 r.p.m., while the dry weight of the car is about 8¼ cwt.

Shown BOTTOM is an Abarth car, based on the Fiat 500, built for record attempts on the Monza track. Recent Class "H" records established by this vehicle include 500 miles at 165·74km per hour and twelve hours at 160·27km per hour, with a fastest lap of 174·23km per hour (108 m.p.h.). The Pinin Farina body, which encloses headlamps, together with the other low-drag bodies on the 750 c.c. and 850 c.c. tuned Fiat cars on this stand, refute resolutely the widespread belief in this country that Italian styling subordinates aerodynamic and æsthetic excellence to ease of construction.

1959 Motor Show

The 44th International Motor Exhibition of the Society of Motor Manufacturers and Traders was opened at Earls Court on Wednesday last week by the Prime Minister, Mr. Harold Macmillan. The exhibition ends to-morrow at 9 p.m.

IN accordance with the custom of recent years, the 1959 motor show is the occasion for the introduction of very few new models from British factories. A number of the new foreign cars are making their first appearances in this country, however, and one of the compact cars that are entering into production in the United States of America was announced during the show. Two cars that are drawing much attention, having never been displayed in this country before, are the "Moskvitch" and the "Volga." The specifications of these cars are not remarkable, and would hardly be considered advanced in this country, the engines being "square" water-cooled o.h.v. four-cylinder units, the gearboxes synchromesh and the rear suspension Hotchkiss drive. The subjective impression gained is, however, more favourable: the handbrake can be released by twisting the "umbrella" handle, for instance, and the seat backs are both adjustable and able to fold down to make a bed. One respect in which the cars appear to be unique is that the performance figures are quoted with full load.

A new British car with several interesting details is the A.C. "Greyhound." The angular nose is reminiscent of cars which have their luggage space at the front, but, in fact, the "Greyhound" has the very deep Bristol engine fitted at the front. It will be recalled that whereas Bristol fit the transverse leaf spring as the bottom wishbone of the front suspension, the "Ace" uses the rigid wishbones to carry the braking loads and the spring passes in front of the engine. In designing a four-seater car it was therefore necessary to change the front suspension in order to bring the engine further forward, and coil springs are now used. The rear suspension also has been changed to coil springs, and to avoid the complication of two sets of wishbones, a swing arm fabricated from three tubes is used: the pivot axis is skewed to avoid raising the roll centre excessively. The body is of light alloy panels on a steel tube frame, and plastics are used extensively to obtain quietness without adding heavy damping. The new car is at present available only with 2-litre or 2·2-litre Bristol engines; it may be regarded as a successor to the aerodynamic "401" and "403," but is apparently less highly streamlined, the door handles and bumpers being outside the envelope.

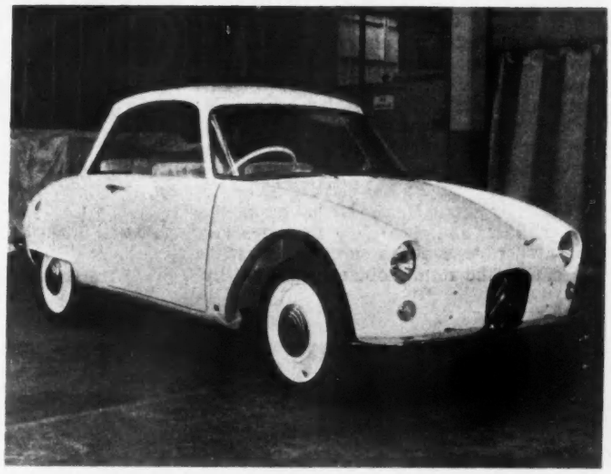
A car of new appearance is a radically different version of the Citröen 2 c.v. which has been evolved by Citröen Cars, Ltd., in this country. While the original car gained its toughness at a sacrifice of appearance and ease of cleaning, the English version has a body moulded from polyester resins reinforced with glass fibre.

The new version is an occasional four-seater with two doors and a large luggage compartment. The mechanical components are unaltered from the earlier car; it will be recalled that it differs from English front-wheel-drive designs in using inboard brakes, and from German light cars in having a separate starter motor driving through a gear reduction. An interesting detail is that by designing for Lucas light units with no filament shield, the need to adjust the setting of the lights with centre of gravity travel, that is imposed by a sharp cut-off of the meeting beam, is avoided.

Another unfamiliar body is a saloon on the chassis of the Daimler sports car. The "Dart" SP250 differs interestingly from the former 2½-litre roadster, notably in having a direct-top synchromesh gearbox in contrast to the two-reduction one-over-drive epicyclic transmission of the single-bank six-cylinder engine. The new engine is a near-square V-8 with valve gear following the familiar Peugeot pattern, and with a compression ratio of 8·2 gives a maximum brake mean effective pressure of 150 lb per square inch at 3750 r.p.m.; at the quoted maximum of 140 b.h.p. at 5800 r.p.m. the power curve is still rising with speed.

Daimler has now introduced a second V-8 engine, becoming probably the only manufacturer other than Ford ever to have two different V-8 engines in production in this country. The new engine is of similar conception but 4½ litres swept volume, and runs up to 5500 r.p.m. for an output of 220 h.p.; in the "Majestic Major" this power is handled by the same Borg-Warner transmission as is used in the 147 h.p. "Majestic." In view of the tendency for the V-8 engine to drift down from the highest engineering standards to use in a large proportion of all cars, it is worthy of record that the detail design of these engines includes double contact breakers on an eight-lobe cam, so that phasing is inbuilt.

A welcome re-appearance was made this year by the chassis dynamometer. The test bed shown by Triangle Products, Ltd., is a development of their "speed rolls" which allow the transmission as well as the engine to be run when the car is stationary, but do not allow any significant load to be imposed. Experience with the "Dynamic" (continuously motoring) brake tester drew the maker's attention to the high order of power losses in transmissions, and led to the construction of a dynamometer incorporating a Heenan and Froude motor brake, the "I.E." (in-expensive) high-speed model. The brake is driven by the rear rollers, which are coupled together, the whole assembly being balanced, since the small size of the rollers results in a speed of the order of engine speed. The front rollers drive only the speed signal generator, and so it is not possible for the car to climb off the rollers; the provision of a lock for the front rollers to allow the car to be driven off was rejected owing to the possibility of introducing out-of-balance forces, and so the plates in between the rollers must be jacked up to remove the car. Simulated seizures of the rollers have been shown not to be dangerous, since in top gear the engine is unable to keep the wheels turning once



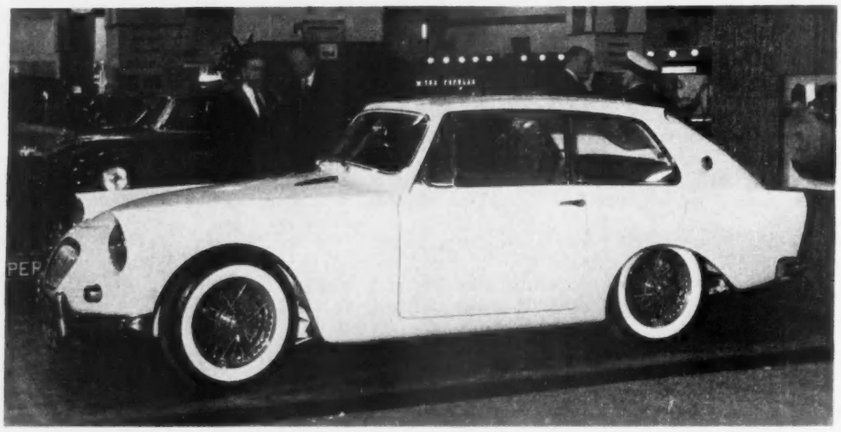
"Bijou" is the name given to the 2 c.v. Citroen with an English coupé body constructed of plastics. The entire nose swings forward for access to the engine, transmission and front brakes

The four-seater A.C. "Greyhound" has a 2 or 2·2-litre Bristol engine. Notice that the brakes are disc front and drum rear

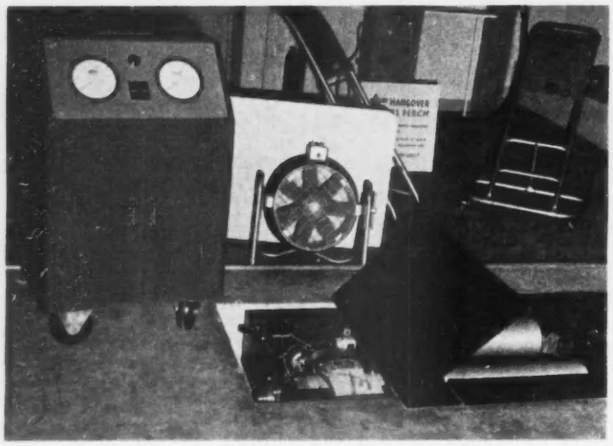
they rest on ground virtually stationary relative to the car.

The dynamometer has a nominal capacity of 100 h.p. which means that vehicles with up to 120 installed horsepower can be tested ; there is sufficient braking available to measure the maximum top gear tractive effort of virtually any car. The brake is swung on lubricated bearings and restrained by a lever arm attached by a sprocket chain to a coil spring ; our illustration shows a socket on the casing to accept an arm for dead-weight calibration. Since the torque signal is linear—assuming a uniform coil spring—it is a simple matter to transfer the output to a uniformly wound potentiometer. The potentiometer is energised with the signal, linear within 1 per cent, from the tachometer generator, and the voltage at the pick-off point corresponds to power ; thus the control desk displays speed and power directly on two dials. The control desk is connected to the brake only by cables, so that it can be positioned conveniently beside the engine bay or driving seat of the vehicle. The desk has cupboards for the instruments and tools that will be used for assessment and diagnosis while the vehicle is running under load. A Woods axial fan running on the electric mains is provided to simulate air intake ramming. It is claimed that, providing the tyres are inflated hard enough to suppress excessive deflections, the results obtained are closely comparable with those from a dynamometer with large rollers.

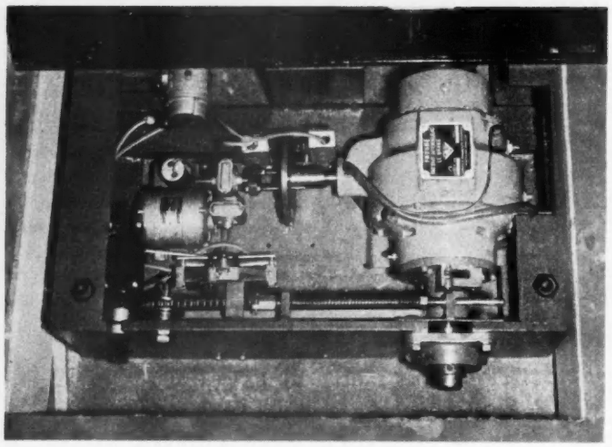
A different approach to this problem yielding a cheaper end product is in evidence on the stand of Crypton Equipment, Ltd. Here the rollers drive an air brake, the power consumption of which can be varied by cranking its shroud along its axis. No torque measurement is made, but it is hoped that the fans will be sufficiently stable for the power to be deduced from the speed, the shroud setting, and the ambient conditions ; at this stage there is not sufficient experience—only three have been built—for any claims to be published. If the effects of atmospheric temperature and pressure upon the engine output and the fan consumption prove to be similar, it can be conceived that a very simple check on a car could be afforded. While a comparator such as this would be useful to a works maintaining fleets of nominally identical



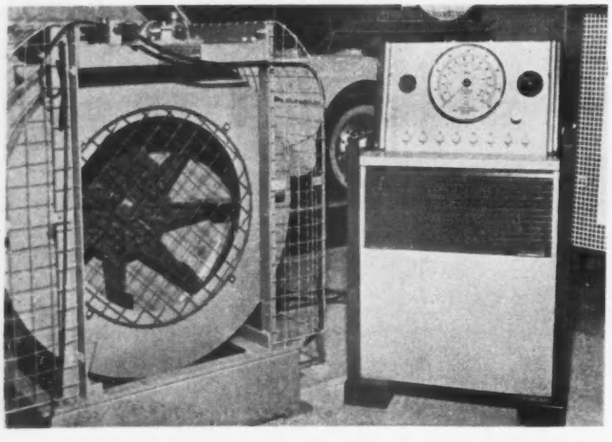
The Hooper body on the 2½-litre V-8 chassis has a recognisably Daimler cooling air intake



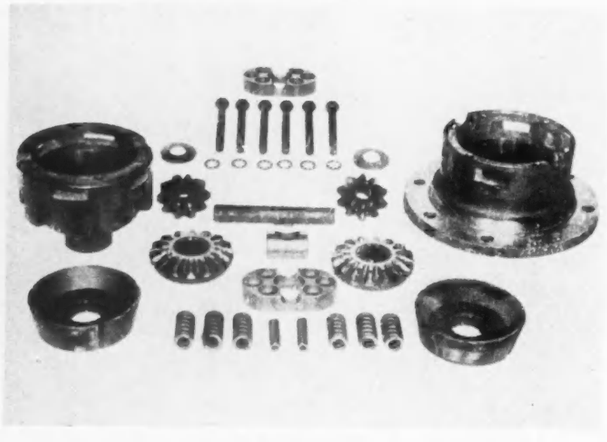
The "Triangle" chassis dynamometer uses a pair of small rollers to load the driving wheels, and hence avoids the need to restrain the car against driving off the test bed



A water brake is coupled to the rear pair of rollers and a tacho generator to the front : read-out is automatic



This performance comparator employs a calibrated fan brake, and measures only the speed attained



A simple spin-resistant differential dismantled to show the spring-loaded cone brakes

vehicles, the maker considers that its simplicity may gain it wider acceptance, although if a measure of the performance of one isolated vehicle is to be made, either the car maker or Messrs. Crypton would have to test examples on this comparator and publish such figures as "at setting 2·2 at least 55 m.p.h. should be attained." An electric monitoring system is provided to assure the operator that the shroud setting is in fact that selected.

Another Crypton exhibit is a transistorised tachometer for spark-ignition engines. This uses an inductive pick-off, it being necessary to do no more than connect the instrument to the vehicle electric supply and wrap the sensing wire around the coil lead. The instrument is claimed to be accurate within 1 per cent and resistant to shock and vibration ; being connected only to electric wires it can be mounted virtually without restriction in the cockpit.

Another interesting item of test equipment is shown by Merlin Engineering Company, Ltd., in the form of a rig for testing the Cummins "PT" fuel pump. The pump itself is mounted on a "Merlin" variable speed test bench, and the inlet and delivery connections made to the special rig. Calibrated orifices are provided to simulate an engine at full load and at idling, and a restriction in the suction pipe can be closed to test the unit as a lift pump. Provision is made for the delivery of fuel to a measuring glass to obtain a direct check on throughput.

We illustrate a dismantled spin-resistant differential displayed by Borg-Warner, Ltd. This unit is in effect a conventional bevel differential with the addition of conical metal-to-metal brakes between each half shaft and the differential cage ; thus when the shafts are running at different speeds the brakes are sustaining a torque and the differential is able to generate much more effort than corresponds to twice the torque accepted by the wheel with least grip. The brakes are applied by forcing apart the bevels on the half shafts by a pack of springs ; in addition, torque applied to the differential casing will invoke an additional force tending to separate the bevels and load the brakes. Thus the functioning is not fundamentally different from that of the Thornton "Powr Lok" differential, exhibited at Earls Court by Salisbury Transmission, Ltd., although in this case the input torque alone loads the brakes, and cams acting on the ends of the bevel shafts are used to generate the axial forces.

There is displayed by Remax, Ltd., the Sovy hydraulic reservoir monitor. This consists of a filler cap for the hydraulic reservoir with an electric low-level detector switch operated by a float ; the shaft carrying the float projects out of the switch in order that the circuit can be tested by forcing the float to sink. The signal normally takes the form of a warning light.

The L.C.C.'s Northern Outfall Works

With the opening last week, by the Duke of Edinburgh, of the secondary treatment plant at the London County Council's Northern Outfall works at Beckton, and the substantial completion of a large installation of sludge digestion tanks, a stage has been reached where an overall description of the Northern Outfall works may be given. The description hereunder is supplemented by information on the new works given in the pictorial pages. The illustration, right, shows a typical aeration channel of the secondary treatment plant, with the diffusers arranged for spiral flow.

THE Northern Outfall Works were brought into operation in 1864, when the construction by the Metropolitan Board of Works of three of the present outfall sewers and four large storage reservoirs capable of holding six hours' dry weather flow was completed. No sewage treatment was attempted as the sewage was simply stored in the reservoirs and discharged on the ebb tide.

In 1889 the London County Council constructed covered sedimentation channels with a capacity of 13 m.g., sludge settling beds, sludge pumping plant, overhead sludge storage tanks and the sludge vessel service for disposal of sludge at sea was initiated. It was not until 1931 that a surface aeration plant to treat 10 m.g.d. of sewage was brought into operation. Between 1935 and 1939 this plant was enlarged so that up to 60 m.g.d. could be treated. By 1955 new detritus pits and primary sedimentation tanks had been completed.

A diffused air plant to give secondary treatment to a further 60 m.g.d. of sewage, a sludge digestion plant to treat all the sludge produced on the works and a power house complete the present programme of extensions at Northern Outfall Works, but provision has been made for additional plant.

The area draining to the Northern Outfall Works comprises the whole of the County of London north of the River Thames, together with the out-county areas of East Ham, West Ham, Ilford, Barking, Leyton, Walthamstow, Hornsey, Tottenham, Wood Green, Willesden and Acton, of 112 square miles and with a population of nearly 3,000,000.

In the area draining to the Northern Outfall there are 237 miles of main sewers in the charge of the Council, 1220 miles of local sewers in the charge of the Metropolitan Borough Councils, and over 1000 miles of sewers in the areas of the out-county authorities. There are six pumping stations operating on the north side of the river in the county, with an aggregate pumping capacity of 70,000,000 gallons an hour. Five 9ft by 9ft horse-shoe-shaped brick sewers built in an embankment convey the sewage and storm water to the works. No pumping of sewage is required as the sewage flows by gravity through the works and the treated effluent discharges to the River Thames at Barking Creek. The water level in the incoming sewers at times of peak dry weather flow (178 m.g.d.) is 17·10 O.D. (Liverpool), and the effluent from the secondary treatment plants flows over weirs at 14·90 O.D.

The site of the works is on marshland and the strata consists of peat and poor quality clay overlying ballast which varies in thickness over the site. The ground water is within a few feet of the original marsh level.

The first stage in the sewage purification process is the removal of grit and sand in the detritus pits, followed by the removal of rags by mechanically raked screens. After disintegration the rags are returned to the sewage, which then passes to the sedimentation tanks, where approximately 70 per cent of the suspended solid matter in the flow settles to the floor of the tanks as sludge.

After this preliminary treatment, the sewage flows to the aeration sets, where intensive air blowing in the presence of activated sludge effects purification and the mixture of sewage and activated sludge passes to final settling tanks, where the activated sludge is settled out and returned to the aeration sets and the clarified effluent discharges over weirs to the main effluent channel and finally to the river.

Sludge from the sedimention tanks is pumped to dewatering tanks and then to primary digestion tanks, where the sludge is heated to 85 deg. Fah., utilising waste heat from the power house, and sludge gas (70 per cent methane, 30 per cent CO_2) is evolved and used in the gas turbine plant.

After primary digestion the sludge is given a further period of digestion in secondary tanks, where approximately 40 per cent of the volume of sludge is drawn off as liquor and pumped back to the sewers. The digested sludge is finally disposed of in sludge vessels at sea.

Preliminary Treatment

Detritus Pits.—Six pits each 130ft long, of varying widths, are provided to deal with flows up to a rate of 750 m.g.d. The invert level of the pits is 11ft below the incoming sewers. Flow to each pit is controlled by hydraulically operated penstocks to maintain the velocity between 0·8ft and 1·2ft per second. Within this range of velocities the sand and grit in the sewage settle in the pits. At intervals a pit is laid off and after the supernatant liquor has been decanted by weiring penstocks the grit in the pit is removed by a Holman drag-line scraper which deposits the grit on a moving belt for conveyance to a storage hopper. The grit is finally disposed of as fill on adjacent low-lying land ; dumpers of 3 cubic yards capacity transport the grit from the storage hopper.

In the control house at the downstream end of the pits remote control panels for operating the penstocks are installed, together with hydraulic pumping sets and a stand-by generator for use in case of a failure in the mains supply of electricity. The amount of grit removed per annum is approximately 10,000 tons.

On leaving the detritus pits, the sewage flow is divided at the distribution chamber on the south side of the screen house. Electrically-operated penstocks control the flow so that in dry weather three-quarters of the flow passes to the new primary sedimentation tanks and one-quarter to the old sedimentation channels.

At times of heavy rain up to 300 m.g.d. is taken by the new tanks and the balance continues down the sewers for treatment in the old channels.

Screen House.—All sewage passing to the new sedimentation tanks is screened. The coarse screens have 5in spacing and the medium screens 1in spacing between the bars. There are six sets of coarse and medium screens.

The screenings collected on the medium screens are mechanically raked and carried by conveyor belts to hoppers where sewage is added as a dilutant and then passed through macerators. The macerated screenings are returned to the sewage upstream of the screens.

There is a control room in the screen house where all penstocks adjacent to this house can be operated. This room also contains the Venturi meter flow indicators and charts registering the flow through the new sedimentation tanks.

Pre-aeration.—After screening, the sewage is given pre-aeration treatment in the twin supply channels leading to the sedimentation tanks. Three rows of 7in diameter domes are fitted in the floor of each of the channels and air is supplied by electrically-driven " Roots " compressors: 3000 cubic feet of air a minute is supplied and the retention time in the channels averages twenty minutes.

Primary Treatment

Sedimentation Tanks.—The sixteen sedimentation tanks, each 250ft long between inlet and outlet weirs, 75ft wide and 11ft deep, have a total capacity of 20 m.g. and are designed to treat a maximum rate of flow of 300 m.g.d. The level of the inlet weirs to the tanks is 0·1ft below the level of the double outlet weirs. Sludge is swept by electrically-driven Mieder scrapers to troughs at the inlet end of the tanks, where transverse flight collectors sweep the sludge to hoppers situated between each pair of tanks. Sludge is removed from the tanks once in every eight-hour shift and flows by gravity via a pipe connected to each hopper over telescopic weirs to sumps at the sludge pump house, from where it is pumped to the dewatering tanks and thence to the primary digestion tanks.

Four sludge pumps, each of 600 tons an hour capacity, are provided in the sludge pump house, which also contains two 1000 tons an hour drainage pumps. The sludge pumps come into operation automatically in accordance with the level of the sludge in the sumps. In the sedimentation tanks approximately 70 per cent of the suspended solids in the sewage is removed and the sedimented effluent passes over the outlet weirs to a channel connected to a distribution chamber where automatically operated electrically-driven penstocks control the quantity of flow passing to the new diffused air plant and the old activated sludge plant for secondary treatment.

As at the present time only a proportion of the flow receives secondary treatment, a spillway channel by-passes surplus flow to the main outfall.

Old Sedimentation Channels.—There are thirteen covered channels of average length 650ft by 31ft 6in wide, with a water depth of 8ft 6in below the outlet weir level. The total capacity is 13 m.g. The channels are operated as six separate units and normally a unit is laid off every three to four days and the supernatant liquor drained to sludge level. The sludge gravitates to a sump, from whence it is pumped to the dewatering tanks of the sludge digestion plant.

The effluent from the tanks flows via a Venturi flume, to the main effluent channel.

Secondary Treatment

Activated Sludge Plant No. 1.—This partial treatment plant which was completed in 1939 operates in a different way from the new diffused air plant.

In the old plant the activated sludge is re-aerated by air blowing for approximately sixteen hours in re-aeration channels, somewhat similar in design to the " ridge and furrow " aeration sets of the new plant, before being returned to the aeration sets. In the six aeration sets the activated sludge and sedimented sewage are mixed and circulated by paddles in double compartment channels with intercommunicating ducts before passing to the final settling tanks. The respective capacities of the re-aeration channels and aeration sets are 7·2 m.g. and 7·0 m.g.

There are nineteen final settling tanks, with a total capacity of 6,000,000 gallons. The sludge from the final tanks is pumped to the re-aeration channels by automatically controlled centrifugal pumps.

Activated Sludge Plant No. 2 (Diffused Air).—The new diffused air plant has been designed to treat 60 m.g.d. of sedimented sewage but provision has been made at the distribution chamber to allow for future extensions to the plant. The diffused air plant comprises six aeration sets, an operating gallery, fifteen final settling tanks, a control house and a surplus sludge and maintenance pumping station.

Aeration Sets.—The aeration sets have a total capacity of 22·8 m.g., giving nine hours' retention time for a flow of 60 m.g.d.

Each aeration set has eight channels 16ft wide by 390ft long and 7in diameter. Dome diffusers are fitted to 4in diameter air mains on the floors of the channels.

For " stepped " aeration, sedimented sewage can be added at the first, third and fifth channel of each set and " tapered " aeration is also possible. Four of the sets have the air diffusers laid at one side of the channel and are operated on the spiral flow principle. In the other two sets the normal ridge and furrow method of air diffusion is used.

The flow of sewage mixed liquor and return of activated sludge to each aeration set is measured on Venturi flume meters.

The total quantity of air supplied to the diffused air plant including air used in service channels and air lifts is 70,000 cubic feet of free air a minute at 6½ lb to 7½ lb per square inch pressure.

The mixture of sedimented sewage and activated sludge (or mixed liquor) flows through the eight channels of each set in series before passing to final settling tanks where the activated sludge is settled out and returned to the aeration sets.

Final Settling Tanks.—These tanks are 110ft in diameter and the depth of the flow below the circular double outlet weir is 12ft at the periphery and 14ft at the centre. The activated sludge settles to the floors of the tanks and is scraped to central troughs by " two-arm " Dorr scrapers. Sludge is then returned to the aeration sets via pipelines, air lifts and service channels. The air lifts are designed to return up to a maximum of 30 m.g.d. to the aeration sets.

The clarified final effluent discharges over the outlet weirs to the main effluent channel and thence to the river. Surplus activated sludge produced as a result of the secondary treatment of the sewage is pumped to the inlet end of the pre-aeration channels.

Operating Gallery.—The operating gallery is over 1000ft in length and 46ft wide and contains the branch air mains, drain, surplus sludge main and most of the flow meters. The main controls for the operation of the plant are at the intermediate floor level where there are indicators showing the rate of flows of sewage, sludge and air, and the remote control of penstocks are readily accessible. Incorporated in the gallery is the pumping station housing pumps for maintenance drainage of the aeration sets and final settling tanks and the surplus sludge pumps. On the main panel in the control house are indicators, integrators and recorders for the flow of sewage, return sludge and air to the plant.

Sludge Treatment

The crude sludge (including surplus activated sludge) from the primary sedimentation tanks is pumped to four dewatering tanks with a total capacity of 19,000 tons. These tanks are each fitted with a picket fence thickener mechanism and floating arm draw-off and are normally worked as two pairs.

The full sequence of filling and thickening, decanting and emptying occupies forty-eight hours and is automatically controlled by a time clock and relay panel in the primary digestion control room. For continuity of operation of the process the two pairs of tanks are arranged to be twenty-four hours out of phase.

Primary Digestion.—The sludge from the dewatering tanks is pumped simultaneously to sixteen primary digestion tanks via a system of pipes arranged to give uniform distribution. Before entering these tanks, the sludge passes through spiral plate heat exchangers of the " Rosenblad " design where heat is recovered from the outgoing sludge from the digestion tanks. The amount of heat transferred is of the order of 7,500,000 B.Th.U. per hour when the outgoing sludge

is reduced in temperature by 15 deg. Fah.

The primary digestion tanks, sixteen in number, are 80ft diameter by approximately 32ft side water depth and have a total capacity of 76,000 tons. The temperature of the sludge in the tanks is maintained at approximately 85 deg. Fah. by two heaters in each tank placed diametrically opposite each other.

Each heater is supplied with 42 gallons per minute of hot water which enters at 160 deg. Fah. and leaves at 120 deg. Fah. Heat transfer is through four cylindrical and concentric steel surfaces along which the sludge is pumped at a rate of 1840 gallons per minute.

The water is heated by waste heat recovered from the exhaust gases from the gas turbines in the power house.

The sludge in the tanks is circulated by axial-flow pumps working in conjunction with the heaters. Discharge from the latter back into the tanks takes place through a nozzle arranged tangentially so as to induce a rotary motion to the contents of the tank. Scum is drawn off and mixed with the circulating sludge.

Each tank is covered by a spiral-guided floating gasholder bell having a total capacity of approximately 28,000 cubic feet. This represents six-and-a half hours' storage of the normal full day's production of 2,500,000 cubic feet of sludge gas. This gas having a normal composition by volume of 70 per cent methane and 30 per cent carbon dioxide has a net calorific value of approximately 625 B.Th.U. per cubic foot. This is equivalent in value to £520 of diesel oil a day.

Each gasholder is constructed so as to throw a pressure of 5in water gauge during the first half of its upward travel. Above this height, an internal cup lifts increasing quantities of sludge above the general level in the primary digestion tank. This serves progressively to increase the pressure thrown by the gasholder up to a maximum of 8in water gauge at maximum elevation. This feature is designed to maintain all gasholders at approximately the same level when they are kept at states of half or more full.

A comprehensive high and low level warning system gives indication and alarm in the control room. An excess gas burner disposes of surplus quantities of gas when necessary. The equipment can deal with quantities up to 60,000 cubic feet per hour, is arranged for optional remote or local control and carries the flame 30ft above the adjacent ground level.

Secondary Digestion.—After approximately ten days' digestion in the primary tanks the sludge gravitates to four open secondary tanks for a further period of digestion to assist in the dewatering of the sludge and so reduce the volume for ultimate disposal at sea. The storage reservoirs constructed in 1864 have been converted for use as secondary digestion tanks and have a total capacity of 192,000 tons.

Provision is made for decanting liquor at various depths and it is then pumped back to the incoming sewers. In the pump houses adjacent to the secondary tanks four pumps each 2400 tons an hour capacity and two pumps of 200 tons an hour capacity pump digested sludge to overhead storage tanks or direct to the sludge vessels.

Sludge Disposal

Four twin-screw oil-fired sludge ships, each of approximately 1500 tons capacity, are in service for disposal at sea of the sludge from Northern and Southern Outfall Works. Three of the ships have now been in service for more than thirty years and it is proposed to replace them in the near future with two ships of larger capacity. The latest addition to the fleet, the "Edward Cruse," was commissioned in 1954.

The ships are operated on an eighteen tides per fortnight cycle and the sludge is deposited at the Black Deep some 55 miles from the works.

Power House

The basement and superstructure of the power house are constructed in reinforced concrete. The roof is constructed of precast sections supported on the valley beams and post tensioned *in situ*.

The machinery includes five gas turbine blowers, three gas turbine alternators, air filtration plant, gas compressors, heat exchangers, waste heat boilers, and other ancillary plant. To ensure that a clean air supply was available for the diffusers of the diffused air plant and the gas turbines, six electrostatic precipitators each filtering 45,000 cubic feet of air per minute are installed : 100,000 cubic feet of free air per minute is required for air diffusion in the activated sludge plants and the electrical power demand on the works is approximately 1865kW. The gas generated in the sludge digestion plant is sufficient to meet the full power requirements. Oil fuel may be used if necessary in the gas turbines and an alternative electricity supply is available from the London Electricity Board. Waste heat recovery from the gas turbines supplies approximately 20,000,000 B.Th.U. an hour for heating the sludge in the primary digestion tanks and additional heat is available from two gas- or oil-fired water heaters.

Gas Turbines.—Eight similar units each of 960 b.h.p. are used for driving both blowers and alternators. They are open cycle two-shaft machines. The sets can be made independent of mains electricity supply as the starter motors, emergency forced lubrication pumps and diesel oil fuel pumps are all battery driven.

The brake thermal efficiency of the gas turbines will be approximately 21·2 per cent and the waste heat recovery mentioned above will improve the overall efficiency of the installation to approximately 50 per cent.

Hot Water Heaters and Hot Water System.—The eight water heaters associated with the gas turbines are designed each to extract 3,100,000 B.Th.U. an hour from the exhaust gases and to heat the circulating water for sludge heating from approximately 125 deg. to 165 deg. Fah. Two supplementary water heaters, of similar design to an economic boiler, are installed and each can supply 5,800,000 B.Th.U an hour during very cold weather for initial heating of the digestion plant.

The quantity of heat required by the sludge will vary seasonally between 20,000,000 and 32,000,000 B.Th.U. an hour and as a constant quantity of water is circulated, heat variation is obtained by change in water temperature. Branches from the hot water system are taken to the ventilation plant and the heaters on the main oil storage tanks.

Alternators.—Three alternators are installed running at 1500 r.p.m., each generating 620kW at 3·3kV and 0·8 power factor. The units will run in parallel with each other and also with the London Electricity Board's supply which will meet any station requirements in excess of that generated locally.

Gas Compressors and System.—Sludge gas is delivered at a pressure of not less than 4in water gauge to the power house and is controlled by a master valve operable either from outside the power house or inside the gas compressor room. Five reciprocating compressors are installed which deliver at 120 lb per square inch to two receivers each of 1050 cubic feet capacity.

Cooling Water System.—Cooling water for compressors, oil coolers and induced draught for bearings is drawn from and returned to a spray pond adjacent to the power house. A branch from this system supplies water to the "Mulsifyre" fire fighting system.

Control and Instrumentation.—Instruments are fitted to provide complete information on plant operating conditions. The principal instruments and controls are grouped in the control room, from where operation will be directed, including a main electrical control panel for the remote operation and control of the 3300V and 415V switchgear, alternators, and gas compressor motors. The control panel is complete with a mimic diagram which gives immediate indication of the switching arrangements and plant in service. Adjacent to each gas turbine is a console containing the equipment to operate the set as a unit. All instruments associated with plant performance are recording, so that efficiency of operation can be determined over any period of time.

Contractors

The entire programme of works at the Northern Outfall has been under the direction of the chief engineer of the London County Council, Mr. J. Rawlinson, M.I.C.E., and of his departmental staff. Construction of the channels and tanks of the secondary treatment plant was described in THE ENGINEER of April 19, 1957, and of the primary tanks and screen house in our issue of July 1, 1955.

The principal contractors for the diffused air plant, sludge digestion plant and power house are listed below :

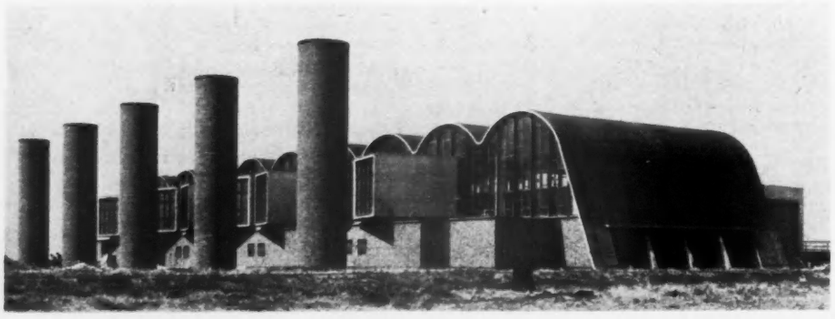
Diffused Air Plant.—Civil engineering, Richard Costain, Ltd.; Bored piles, Piling and Construction Company, Ltd., Cementation Company, Ltd.; Diffuser equipment, Activated Sludge, Ltd.; Final settling tank scrapers, Dorr-Oliver Company, Ltd.; Penstocks and valves, Hartley (Stoke-on-Trent), Ltd., J. Blakeborough and Sons, Ltd., Wm. E. Farrer, Ltd., Ham Baker and Co., Ltd., Whitehead and Poole, Ltd., Glenfield and Kennedy, Ltd.; Pipework, Staveley Iron and Chemical Company, Ltd., Cochranes (Middlesbro) Foundry, Ltd.; Meters, Geo. Kent, Ltd.; Pumps, Gwynnes Pumps, Ltd.; Building work, J. and J. Dean (Leyton), Ltd.; Cabling and installation work, London Electricity Board.

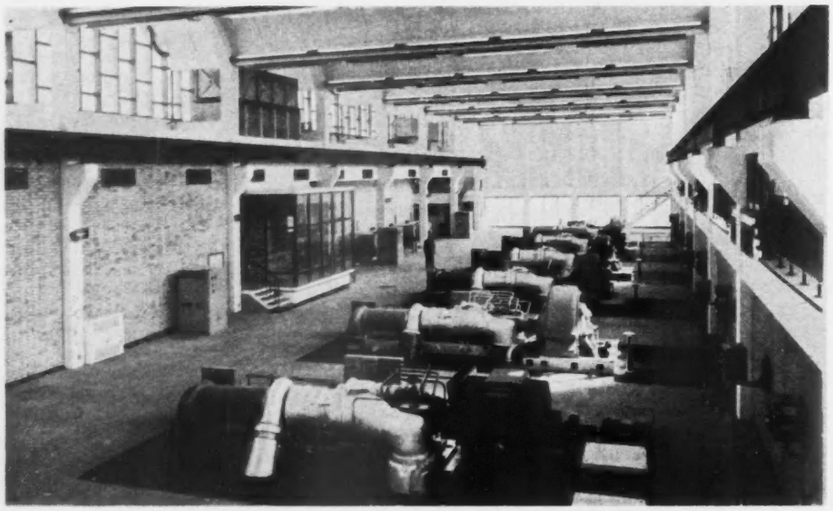
Sludge Digestion Plant : Civil engineering, Demolition and Construction Company, Ltd.; Bored piling, Pressure Piling Company (Parent), Ltd.; Reinforced concrete shell piling, West's Piling and Construction Company, Ltd.; Gasholders, Clayton Sons and Co.; Heating and picket stirring, Dorr-Oliver Company, Ltd.; Heating mains, G. N. Haden and Sons, Ltd.; Pumps, Sigmund Pumps, Ltd., W. H. Allen Sons and Co., Ltd.; Instrument panel, Geo. Kent, Ltd.; Building work, W. J. Marston and Son, Ltd.; Cabling and installation work, Edmundsons Construction Company, Ltd.; Pipework, Stanton Ironworks Company, Ltd.

Power House : Civil engineering, Richard Costain, Ltd.; Building work, Demolition and Construction Company, Ltd.; Main plant contractor, Ruston and Hornsby, Ltd.; Electrical gear, English Electric Company, Ltd.; Plant cabling, W. H. Smith and Co.; Blowers and compressors, Reavell and Co., Ltd.; Precipitrons, Sturtevant Engineering Company ; Pipework, G. N. Haden and Sons, Ltd.; Cranes, The Vaughan Crane Company, Ltd.; Instruments, Kelvin Hughes, Ltd., Geo. Kent, Ltd.; Heating installation, J. Jeffreys and Co., Ltd.; Electric lighting, Duncan Watson, Ltd.; Oil storage tanks, Rye Arc, Ltd.

The Northern Outfall

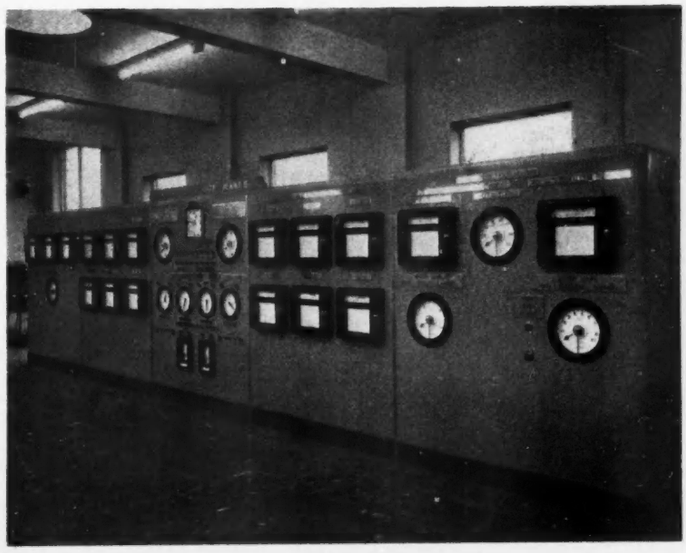
The two UPPER views show the new gas turbine power station. The barrel-vaulted roof structure is built of precast elements cast on the ground and lifted into position. The valley beams are post-tensioned and the architectural effect of the complete structure is enhanced by the colours of the various principal elements.

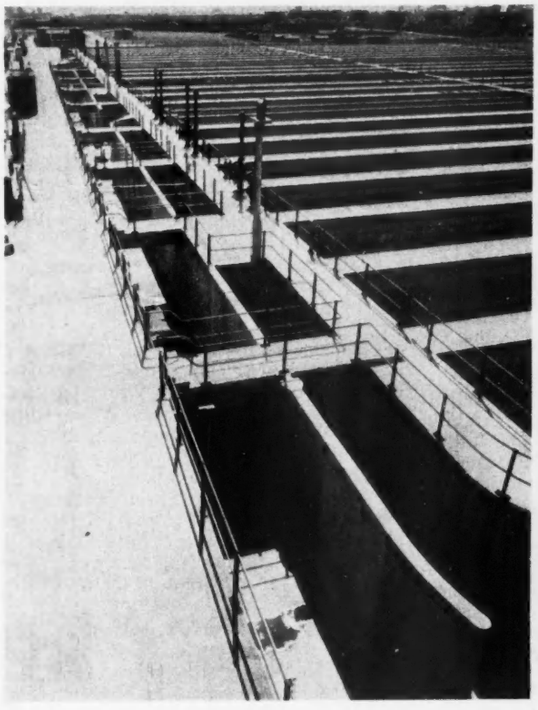


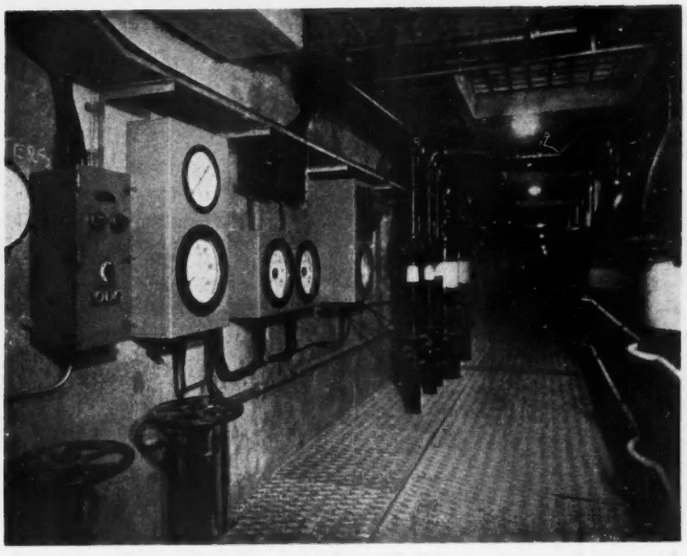


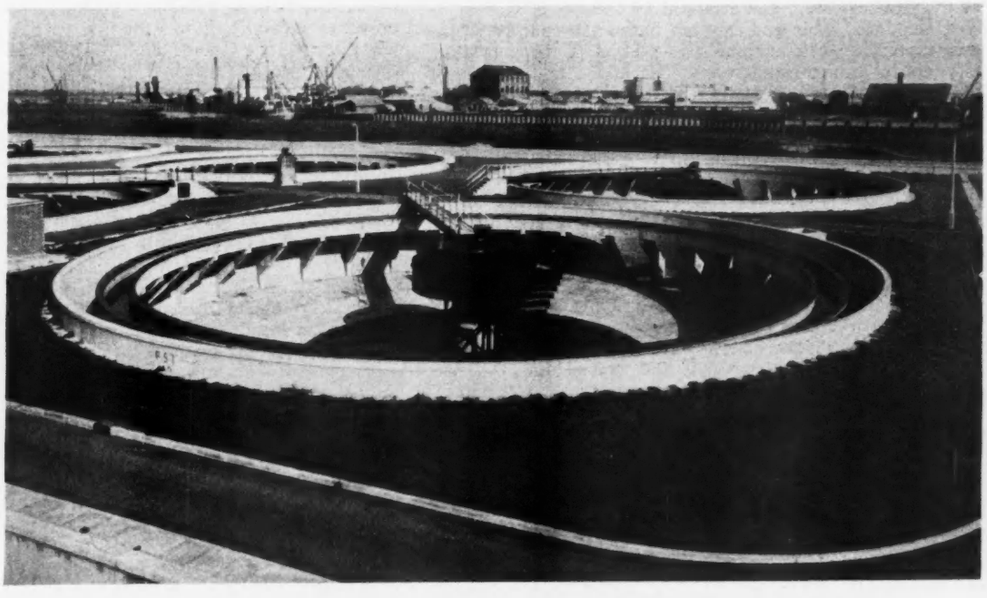
The LOWER view shows the entire Northern Outfall works. The main sewers divide just to the left of the picture, the new screen house being shown on the left, with the supply channels leading from it to the sixteen new (1955) primary sedimentation tanks. The secondary treatment plant and power station opened last week are respectively to the right and in front of these primary tanks. In the foreground is the block of sixteen new primary sludge digestion tanks, with the sludge loading jetty to their right. Just to the right again is the old covered reservoir, now opened up for secondary sludge digestion, and to the right of it again, the actual outfall. Behind this converted reservoir are, on its left, the old covered sedimentation channels which are still in use, and behind them and to the right, the old secondary treatment plant with its aeration channels, final tanks, and re-aeration channels. In the background is the site for possible duplication of the sixteen primary tanks and the secondary treatment plant.

The diffused-air secondary treatment plant. The arrangement of channels, penstocks and weirs at the operating end of the aeration channels is shown on the LEFT. The operating gallery (LOWER RIGHT) runs along below the channels shown, and as may be seen, the main controls for operating the plant are grouped along it in a spacious manner such that all controls, pipework and so on, are readily accessible. The control house (UPPER RIGHT) records principal flows and levels throughout the plant, thus integrating information obtained at various stations along the operating gallery, and elsewhere, and giving a complete picture of operation. This systematic layout with the operating gallery is a novel feature of the plant.









Some of the fifteen final settling tanks are shown on the LEFT. The tank in the foreground clearly shows the circular outlet channel which has a double weir in engineering brick and is cantilevered from the wall of the tank. The two-arm sludge scraper may also be noted. These tanks are each 110ft in diameter and have a depth of 12ft below the double outlet weir at the periphery and of 14ft at the centre. The air-lift extraction system can handle 30,000,000 gallons of sludge per day, returning the sludge to the aeration channels and any excess to the supply channels feeding the primary tanks.

Robert Stephenson, 1803-1859

A MEMOIR

By CHARLES E. LEE*

INTERMENT in Westminster Abbey is a posthumous honour which Great Britain bestows upon some of her greatest sons. Succeeding generations sometimes doubt the wisdom exercised in the selection for such honour, but contemporaries had no doubt that the recipient had served his age and generation outstandingly well in his particular sphere.

One hundred years ago last week, on Friday, October 21, 1859, the body of Robert Stephenson was buried in Westminster Abbey on the initiative of the Institution of Civil Engineers, after a funeral procession from his home in Gloucester Square, which passed through Hyde Park with the express permission of Queen Victoria. The entire route was lined with spectators, and the proceedings, although privately arranged, "approached the character of a public funeral, from the spontaneity, numbers, and influence of the mourners."[1] Despite the precedent afforded by the interment of Thomas Telford in Westminster Abbey in 1834, some still questioned the propriety of admitting an engineer to companionship with statesmen and warriors. However, the bodies of the two engineers who spanned the Menai Straits, one by road and the other by rail, were laid side by side.

The Times[2] commented that "war and statesmanship no longer monopolise the action of the world ; we have a new class of men of action, and public men whose function is to battle with nature to improve the physical welfare of mankind, and to increase the resources, the facilities, and the conveniences of life. This was Robert Stephenson's task, and he did it nobly ; and of him, as truly as of any benefactor of the human race that ever lived, may it be said, *Si quaeras monumentum, circumspice*."

Robert Stephenson died on October 12, 1859, only twenty-seven days after Isambard Kingdom Brunel, and, almost inevitably, the similarities and contrasts of the parallel careers were considered both then and subsequently. Indeed, this was expressed in Robert Stephenson's obituary notice in *The Times*,[3] which began : "The death of Stephenson comes with startling rapidity upon that of Brunel. Both men of rare genius, and both occupying a sort of double throne at the head of their profession, they have gone to their rest together, and their rivalry has ceased. Distinguished sons of distinguished fathers, the two men who in these latter years have done most to perfect the art of travel, and in this way to cultivate social intercourse, multiply wealth, and advance civilisation, have been struck down at one fell swoop in all the maturity of their power."

Even at the time, the "double throne" was by no means universally recognised. In its obituary notice of Brunel, THE ENGINEER[4] did not blind itself to the defects of its subject, both those of character and also of engineering acumen. It remarked that "in all his works he showed a degree of boldness, almost amounting to professional abandon, which many of his contemporaries considered imprudent, and which, it must be said, was imitated by very few of those engaged upon similar works." A centenary reappraisal in THE ENGINEER of September 11 concluded that he lacked the essential qualities of an engineer, and was not entitled to the veneration accorded him by his biographers. It is not the intention of the present writer to contribute in these notes to the resultant discussion, but only to ask (and endeavour to answer) the natural question as to whether the life and work of Robert Stephenson call for any comparable reappraisal.

A correspondent has pointed out truly that it is unjust to relate Brunel to a twentieth century background, and therefore it would seem desirable to sketch the background against which both Stephenson and Brunel worked. Robert Stephenson, the younger Brunel, and Joseph Locke have been called the great triumvirate of the engineering world.[5] They all undertook a variety of work that is almost unthinkable in an age of specialisation and, with their passing (Locke died on September 18, 1860), what may be termed the heroic age of engineering was over. The work of these men, and of many others of lesser stature, in meeting the clamant needs of the industrial revolution for improved transport, had itself caused further need, to satisfy which it was necessary to build in advance of theoretical knowledge, and of metallurgical and chemical progress.

The world was short of technicians, and known engineers received many demands on their services which could be met only by trial and error. It was an age of sturdy private enterprise, when the principal (and usually the sole) criterion was an economic one. Success was achieved by a nice balance of skill, boldness, and prudence, which, being exercised in advance of precise knowledge, sometimes savoured of the "inspired guess." In a recent assessment,[6] Dr. W. H. Chaloner of Manchester University observed that the operations of the Stephensons were characterised by solidity of workmanship and cautious finance, in contrast to the brilliant and costly ideas of some of their contemporaries. He added that the object of the Stephensons was to make a railway that would pay, and in this aim they generally succeeded.

Robert Stephenson was born at Willington, on the Tyne, on October 16, 1803. We have seen that *The Times* called him a distinguished son of a distinguished father, which latter was undoubtedly true, but is misleading without qualification. When he was born his father was not distinguished, and the implication of a flying start in life is false. Robert's great-grandfather was a Scotsman who came to England as a gentleman's servant, and settled on Tyneside. His grandfather (after whom he was named) was "Old Bob," who lived and toiled and died in humble circumstances, and was described[7] as "gentle beyond the wont of rude North-countrymen." "Old Bob" and his wife, Mabel, had a family of six children, of whom the second—the renowned George Stephenson—was born at Wylam on June 9, 1781, and could neither read nor write when he was eighteen years of age.

On November 28, 1802, George married Frances (Fanny) Henderson, a domestic servant twelve years his senior, by which time he could sign his name. Their only child to survive infancy was Robert, the subject of this memoir. He was baptised on January 22, 1804, in what was then part of the parish of St. Peter, Wallsend, and the date of birth inscribed in the register is October 16, 1803. There was, of course, no national registration of births at that time. It is doubtful whether Robert ever knew the date of his birth with certainty. The family celebrated it on November 16, which was the date stated by George, and this date was inscribed on the brass plate on Robert's coffin.[8] Samuel Smiles gave it as December 16 in the first four editions of his *Life of George Stephenson*, and this was quoted widely in obituary notices.[9] October 16 is the date on the well-known statue at the approach to Euston Station, and the *Dictionary of National Biography* says specifically "October 16 (not November)." This is probably correct.

Towards the end of 1804, George was engaged as brakesman at West Moor Colliery and moved to the two-room cottage at Killingworth which was his home until he achieved fame and fortune. He enlarged it to a house with four apartments, and as such it survives to-day. There Robert's mother died of tuberculosis on May 14, 1806. In 1812 he was appointed Engineer of Killingworth Colliery at a salary of £100 a year and added about £50 a year to this by the repair of clocks and machinery. At the beginning of 1815 (after he had introduced his locomotive, the "Blucher") George's employers allowed him to take a part-time interest in the Walker Iron Works, at £100 a year, without reducing his Killingworth salary. With his steadily improving financial position, George gave his son as good an education as his circumstances permitted, at John Bruce's Percy Street Academy in Newcastle. Between 1819 and 1822 Robert gained practical experience in coal mining at West Moor under Nicholas Wood, and then studied for six months at the University of Edinburgh.

Meanwhile, George was invited in 1819 to build the Hetton Colliery Railway, and once again his employers consented, so that he held three concurrent appointments. The Hetton Railway, 8 miles long, was opened on November 18, 1822, and employed locomotives, stationary engines, and self-acting inclines. It was the first entirely new railway that George built. This continued to work satisfactorily for nearly 137 years, and was abandoned as recently as September last. The turning point in George's career came in 1821, when he was consulted about the proposed Stockton and Darlington Railway, to which he was appointed Engineer in January, 1822. Robert thus spent his formative years in an atmosphere of dogged endeavour, empirical engineering, and modest success.

There seems little doubt that George deliberately trained his son to supplement and surpass his own achievements, and the younger man soon assumed the position of a partner. Robert was associated with the early days of the Stockton and Darlington Railway surveys, one of which bears his name as engineer. The famous locomotive works of Robert Stephenson and Company was established on June 23, 1823, with Robert as managing partner, although he was then only nineteen years old. Eight years later he joined with Charles Tayleur in founding the Vulcan Foundry at Newton-le-Willows. Between the two dates Robert had travelled extensively. The experience of the world and the aplomb thus acquired

*President, The Newcomen Society

were essential ingredients in his future make-up, but their early acquisition in this way has sometimes been overlooked.

One of the partners in Robert Stephenson and Company was prominent in the affairs of the Colombian Mining Association, a fascinating scheme for reviving gold and silver mining in Spanish America. He thought that its machinery needs could provide important orders for the Newcastle works, and persuaded Robert in 1824 to visit Cornwall and South Wales in the interests of the association. Robert then went to Colombia (where he advised against building a railway between La Guaira and Caracas). He returned to England in 1827 via New York (where he became a freemason on September 21) and Montreal. Almost immediately he paid a brief business visit to Brussels, before returning to Newcastle to concentrate on the immediate task of raising the efficiency of the steam locomotive, then still a slow-speed adjunct of the mining industry.

Much of the work of father and son in the late 1820s and early 1830s was too closely interwoven to admit of assigning exclusive honours. In May, 1828, Robert took charge of the building of the Canterbury and Whitstable Railway on which work had been suspended in 1827, and completed it successfully. It was opened formally on May 3, 1830, and was the first railway in the world to convey ordinary passengers in steam-hauled trains. Moreover, it was the only one to do so in the "Georgian period," as George IV died on June 26, 1830, before the Liverpool and Manchester Railway was opened. Father and son shared the triumph of the "Rocket" and the vindication of the steam locomotive in the Rainhill Trials; Robert was appointed Engineer of the Leicester and Swannington Railway in 1829 because his father was then too greatly engrossed on the Liverpool and Manchester Railway to accept the invitation; and they became joint engineers of the London and Birmingham Railway in 1830.

On September 7, 1833, however, Robert became engineer-in-chief of the London and Birmingham Railway (with the approval of his father) at a salary of £1500 per annum, plus an allowance of £200 for contingent expenses, and undertook the whole work of construction. Its successful completion in 1838, including the famous Kilsby Tunnel, established his reputation as the foremost railway engineer of his period, and it is the opinion of the present writer that he never lost that lead. The London and Birmingham Railway was the important metropolitan section of the first main line railway in Great Britain. It provided the gateway to the north, and its route affected profoundly the whole railway structure north of London. Moreover, it was designed for this purpose, and its works are memorable examples of engineering capacity. They became a guide to succeeding engineers, as did also the plans and drawings prepared at the famous engineering office established by Robert in the Eyre Arms Hotel, St. John's Wood. Here a staff of from twenty to thirty draughtsmen was constantly employed, and it is estimated that for eighteen months as many as thirty drawings a week were produced. The Eyre Arms staff (including George Parker Bidder, later to become President of the Institution of Civil Engineers) constituted a nucleus of engineers which carried the Stephenson tradition far and wide.

Thereafter Robert's career comprised a series of successes in locomotive engineering, railway construction at home and abroad, and bridge building. His services were in increasing demand, and he was responsible for a very considerable proportion of the early main line railway system north of the Thames. After the completion of the final railway link between the metropolis and the Tyne in 1844, George gradually withdrew from railway work, and spent his later years giving increasing attention to the coal mining enterprises he had launched in the Midlands. Robert was inundated with work during the "Railway Mania" period of the mid 1840s and his income was "large beyond any previous instance of engineering gain"—possibly some £30,000 a year. His health proved unequal to the pressure of the demands on his skill and knowledge, but, nevertheless, his output was vast.

Oversea, he undertook railway work in Belgium, Canada, Denmark, Egypt, Germany, India, Norway, Switzerland, and Tuscany. The King of the Belgians created him a Knight of the Order of Leopold, and for his services to Norway he received the Grand Cross of St. Olaf. He was thus a figure of world-wide reputation. Moreover, his introduction of British engineering products to so many places proved of enduring value to British industry.

By reason of the diversity of their activities, it is impossible with the early engineers of the industrial era to name one feature as their greatest contribution to engineering. Robert Stephenson's opposition to atmospheric propulsion, and his advocacy of a standard track gauge, both achieved their objective, with lasting results. Such efforts are generally forgotten (excepting by historians) once the dust of controversy is laid. Similarly, solid foundation work in both civil and mechanical engineering is apt to be overshadowed by the superincumbent structure.

Probably his bridges provide Robert Stephenson's most striking memorial. His High Level Bridge at Newcastle (1849) has completed 110 years of arduous service. It was scheduled in 1950 as an Ancient Monument, but still carries heavy rail and road traffic. The tubular bridge will ever be associated with his name. The Britannia Tubular Bridge across the Menai Straits (1850) remains as a world masterpiece of its kind. He also built two tubular bridges in Egypt, and the Victoria Tubular Bridge across the St. Lawrence at Montreal. The last-named was opened on November 24, 1859, six weeks after the death of its designer. It is 10,284ft in length, and for many years was the longest bridge in the world. It does not survive in original form, as it was rebuilt as a girder structure on the original piers in 1898.

From 1856 to 1858 Robert Stephenson was President of the Institution of Civil Engineers, and on June 25, 1857, he received the honorary degree of D.C.L. at Oxford. He had been elected a Fellow of the Royal Society in 1849. Some foreign honours have been mentioned, and he is said to have declined an offer of knighthood in Great Britain. Despite his success, much of the savour of life ceased with the death of his wife in 1842; they had no children. He remained a widower, and the direct line of George Stephenson failed. Somewhat surprisingly, Robert was keenly interested in politics, and prided himself on being a Tory—"the term conservative was by no means strong enough to express his abhorrence of innovation."[10] He became M.P. for Whitby in 1847, and represented the town until his death. Probably his most important address to the House of Commons was a condemnation of the Suez Canal project, pledging his professional judgment to the unsoundness of the scheme, mainly on economic grounds.

As a man, Robert Stephenson did not belie the filial loyalty with which he responded consistently to paternal devotion. Throughout his career he was a kindly and generous man and a good employer. On the day of his funeral, business premises were closed at noon throughout the Tyne and Wear areas. Ships carried their flags at half mast on these rivers, as on the Thames. Fifteen hundred workmen at the Newcastle locomotive works marched to St. Nicholas Church. During all the years of his success, he assisted educational and scientific pursuits with unostentatious liberality. His will, dated August 13, 1859, also included substantial charitable bequests to the Church of England, to medicine, to education, and to engineering institutions. His personalty was sworn as "under £400,000." At the first meeting of the new session of the Institution of Civil Engineers, in November, 1859, Joseph Locke, the President, paid the following tribute: "Robert Stephenson was the friend of my youth, the companion of my ripening years, a competitor in the race of life; and he was as generous a competitor as he was firm and faithful as a friend. This will, I know, find an echo in the hearts of all around me."

On October 14, 1859, THE ENGINEER said: "The foremost man amongst our engineers has passed away. Robert Stephenson is no more on this earth, save in the memories he has left behind him. Pleasant are those memories to those who survive him and knew him. Nothing base or unworthy clings to them." The succeeding century has produced nothing, in the writer's submission, to justify any fundamental reappraisal of the judgment of his contemporaries.

REFERENCES

[1] *Illustrated London News*, October 29, 1859, page 424. See also THE ENGINEER, October 28, 1859, page 309.
[2] *The Times*, October 24, 1859.
[3] *The Times*, October 13, 1859.
[4] THE ENGINEER, September 23, 1859, page 219.
[5] *The Times*, September 21, 1860.
[6] *History Today*, September, 1956, pages 627–634.
[7] *The Life of Robert Stephenson, F.R.S.*, by William Pole (1864), Vol. I, page 2.
[8] *The Railway Times*, October 22, 1859, page 1178; and Pole *op. cit.* Vol. II, page 267; but wrongly quoted as November 6 in THE ENGINEER of October 28, 1859, page 309.
[9] *The Times*, the *Annual Register*, the *Gentleman's Magazine*, *The Railway Times*, &c.
[10] Pole *op. cit.*, Vol. II, page 143.

Railway Advisory Service for Asia and Far East

IT has been seen at sessions of the Rail Sub-Committee of the Economic Commission for Asia and the Far East that there is a need for information on many subjects outside those aspects of railway operating which can be included in the programmes of work. Consideration has been given, therefore, to means whereby the United Kingdom could further assist the railways of the region by making available experience gained in the course of the British Transport Commission's modernisation programme, and from collaboration with railways throughout the world. In consequence, a Railway Advisory Service has been established to which any railway administration in the region may submit problems in connection with matters such as research, safety, electronics, motive power, maintenance, signalling, permanent way, accounting, statistical procedure, rolling stock and power supplies. Application should be made to the United Kingdom Railway Advisory Service (U.K.R.A.S.), International Inland Transport Branch, Ministry of Transport, Berkeley Square House, London. On receipt of a request, U.K.R.A.S. will call upon the appropriate experts and submit recommendations. If necessary, representatives will visit the country concerned to study a problem on the spot.

Ship Hydrodynamics Laboratory at Feltham

The illustration to the right gives an aerial view of the Ship Hydrodynamics Laboratory constructed at Feltham and opened by the Duke of Edinburgh on October 19. It marks the completion of proposals put forward in 1946 for a new tank to meet the increased demand for resistance and propulsion tests. The new laboratory has a tank 1300 ft long, 48ft wide and 25ft deep, a manœuvring pond 100 ft square, and a 44in water tunnel together with ancillary service buildings.

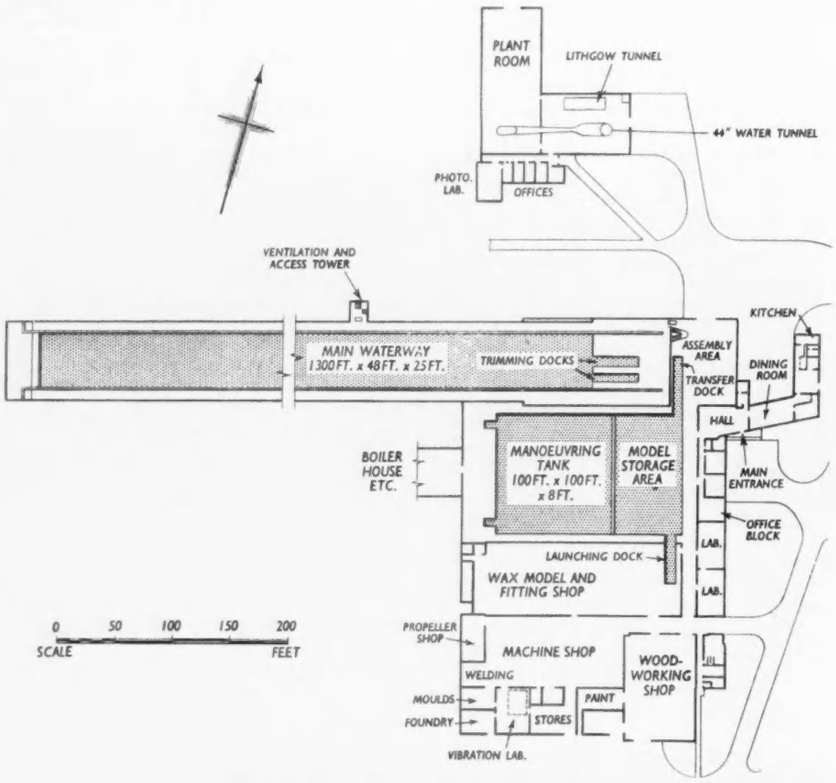
THE opening of the Ship Hydrodynamics Laboratory at Feltham on October 19 by the Duke of Edinburgh marks another stage in the expansion and development of ship hydrodynamic research facilities available to the shipbuilding industry. This latest laboratory is in line of descent from the tank which was built at Torquay in 1871 by William Froude, and was the first to correlate ship model experiments with full-scale performance. That tank, which measured 278ft by 36ft by 10ft, was dismantled in 1886 and the site is now marked by a commemorative plaque erected under the auspices of the Institution of Naval Architects. The experimental work begun at Torquay was transferred to a tank measuring 400ft by 20ft by 9ft, which was built by the Admiralty at Haslar and is still in use. In the meantime the value of tank experiments had been appreciated elsewhere and William Denny and Brothers, Ltd., constructed a tank 249ft by 22·4ft by 8·75ft, which is now the oldest in regular use, while in 1896 Admiral D. W. Taylor built a tank in the Gunboat Yard at Washington.

Although it was realised that ship model experiments would greatly benefit shipbuilders it was not until 1911 that the generosity of Sir Alfred Yarrow made possible the building of a tank 494ft by 30ft by 12·3ft at the National Physical Laboratory. This tank served the industry for twenty years until a second tank measuring 680ft by 20ft by 9ft with a carriage speed up to 30ft per second was built at Teddington. In the succeeding years there has been an increasing demand for resistance and propulsion tests, by builders and owners, such that, despite the fact that there are several tanks owned by private firms, the facilities at Teddington were quite inadequate to satisfy the industry and also sustain a research programme. Proposals for a new tank were formulated in 1945 and found general acceptance, but it was not until 1950 that a site which fulfilled requirements was found within reasonable distance of the N.P.L. at Teddington. Even then national economic considerations delayed any possibility of the work being commenced. Initially the proposals put forward included a tank 1800ft long (to provide a steady run of 700ft at 50ft per second) by 50ft wide by 25ft deep, a 44in water tunnel, a manœuvring or sea-keeping basin and a water circulating channel.

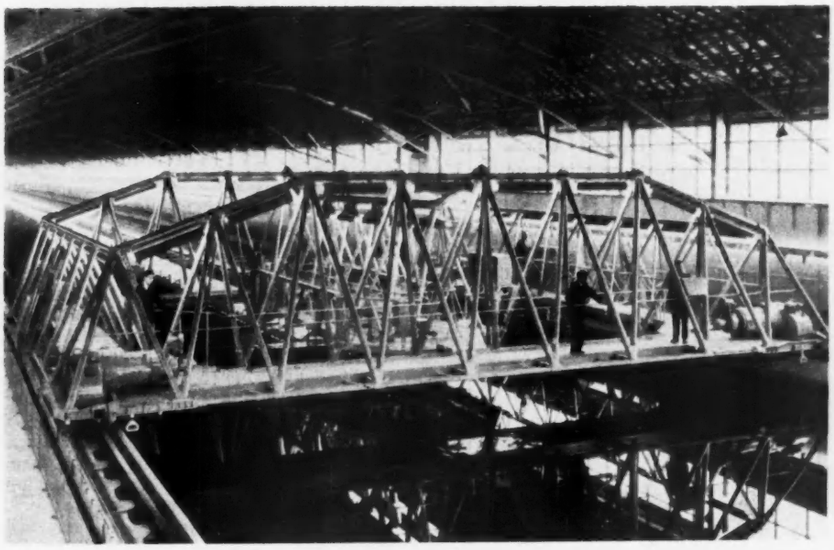
However, the need to keep down to a price caused certain modifications to be made, including the reduction of the length and breadth of the tank by 500ft and 2ft respectively, making the new dimensions 1300ft by 48ft by 25ft, and the elimination of the water channel. Additional saving was effected by deciding to build above ground, thus obviating expensive excavating work and ground treatment. Eventually the first turf was cut in March, 1955, on the site at Faggs Road, Feltham. The layout of the various buildings is shown in the line drawing below.

Design and Construction

The subsoil at the site consists generally of 16ft of ballast and sand overlying London clay, with a fairly stable subsoil water table on the ballast at about 8ft 6in below general ground level. Originally it was planned to place the tank foundations in the London clay with the water level inside the tank 3ft above ground level. However, this would have involved the expensive operation of sheet piling or chemically freezing the perimeter of the excavations in order to



General arrangement of the laboratory buildings



Ship model towing carriage showing two of the four 300 h.p. driving motors

exclude subsoil water, so that it was decided to build the tank mainly above ground level. The resulting savings in cost were considered to offset any disadvantages, such as the additional handling of the ship models, caused by this arrangement.

A total of twenty-two reinforced concrete sections each 57ft long form the 1300ft long waterway which has a cross section 48ft wide by 25ft deep. Each section has a base 4ft thick and side walls which are generally 24in thick and reinforced with buttresses at about 15ft centres. The latter carry the sidewalk and also support the rocker bases for the steel and aluminium alloy superstructure. The 3ft wide gap left between each section was filled with concrete at a temperature of 45 deg. Fah. and later water at 60 deg. Fah. was admitted to the tank so that the fabric was in compression and water-tightness of the joints assured. There are also buttresses at the ends of the tank to take hydrostatic loading and the reaction forces set up by the wave-maker, &c.

A combined steel and aluminium alloy structure houses the tank and is clad externally with asbestos and lined internally with aluminium-faced "Onozote" panels having a "U" value of 0·15. Owing to the humid conditions obtaining in the tank, due to the large area of water, aluminium was adopted for internal structures and surface finishes, and the roof consists of aluminium alloy trusses supporting aluminium decking covered with bituminous felt. Double-glazed windows in the north wall provide natural light, while at the east end is a large window wall. Provision has been made at the west end for extending the tank.

Adjacent to the main tank but with the water at about 3ft above ground floor level is a tank, measuring 160ft by 100ft by 8ft deep, which is divided by a concrete wall into a manœuvring basin 100ft by 100ft and a model storage area 60ft by 100ft. As for the main tank, the housing consists of a steel and aluminium-framed structure. The workshops and stores building is steel framed and asbestos clad and the two-storey office block is also steel framed. A separate steel-framed, asbestos-clad building contains the 44in diameter water tunnel and the main plant equipment for the tank and tunnel buildings and there is space to accommodate the smaller Lithgow tunnel which is at present at Teddington.

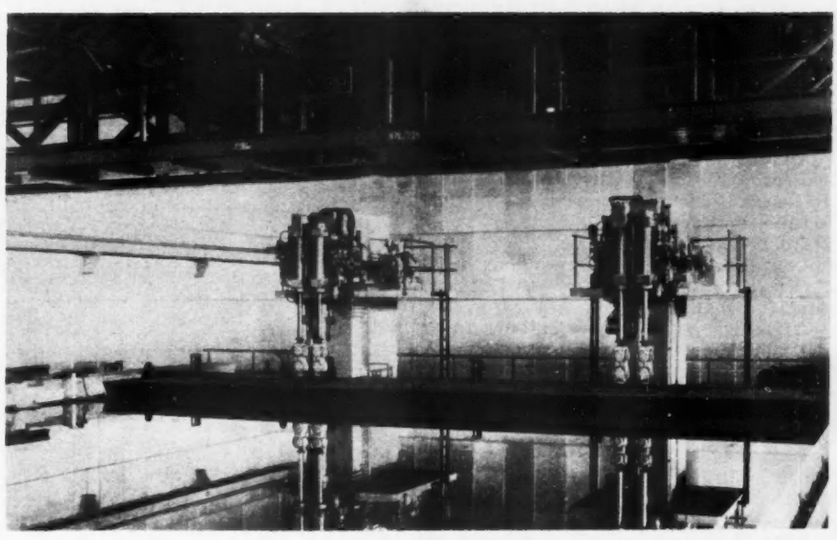
Engineering Services

The towing carriage, supplied by Cravens, Ltd., and illustrated herewith, consists of an open rectangle formed by tubular steel trusses of triangular form and each member is about 50ft long by 6ft wide at base and 14ft high, so that easy access is provided to all points. Within this framework is carried another member of similar form which supports the dynamometer, and this boom has a platform on either side, one of which can be raised or lowered to suit working requirements. The design of the carriage provides for the towing of models weighing up to 5 tons and up to 40ft in length at speeds up to 50ft per second, and combines light weight with adequate rigidity to take the vertical loading and the horizontal loading which has as its limit the load imposed by emergency braking. Propulsion of the 40-ton carriage is by four 300 h.p. d.c. motors, each of which drives a twin-wheeled self-steering bogie which carries the frame on a system of rubber compression springs. Power for the motors is picked up by collector arms from a system of rigid conductors mounted on the tank walls, thus there are no overhead wires. A speed-holding servo maintains set speeds within 0·1 per cent and limits the acceleration rate to a preset value, the maximum rate being 3·2ft per second per second.

Since the carriage has high kinetic energy at high speed, considerable attention has been paid to braking arrangements. Regenerative and dynamic braking systems are provided and there are also mechanical caliper friction brakes in which the shoes operate on a brake rail. The spring-operated brakes are held off pneumatically so that they fail to safety in the event of loss of air supply which is stored in the top tubes of the longitudinal side frames. Since the length of the tank limits the duration of maximum speed it is necessary to utilise fully the length available and to assist in this track switches, which are duplicated and bring on electrical and mechanical brakes, enable the carriage to be brought to rest automatically, the maximum deceleration rate being 0·25 *g*. Another set of track switches permits maximum duration of low speed runs while additional sets of switches guard against over-running under manual control. In the unlikely event of the failure of all the braking systems, an aircraft arrester gear is fitted and on the underside of the carriage is a shock-absorbing nylon harness designed to engage hooks located on the inside of the tank walls.

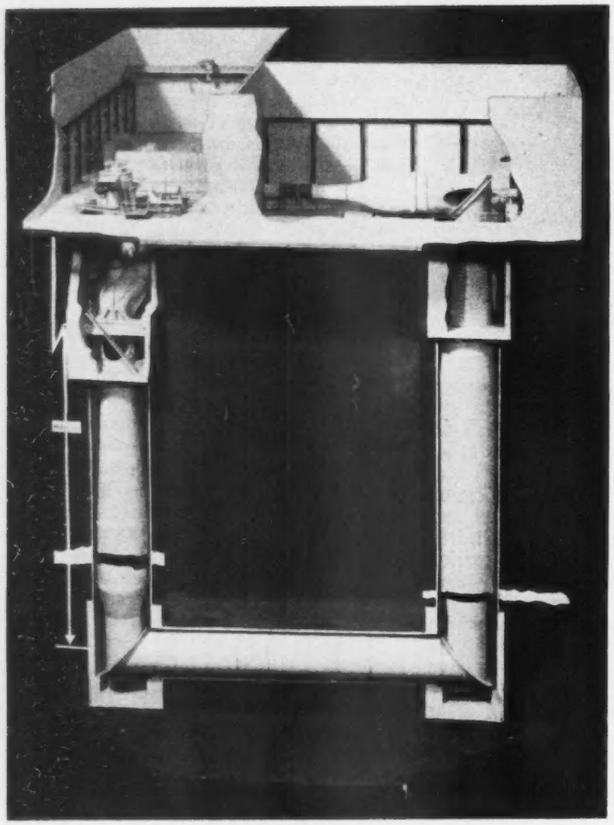
The carriage runs on special section 260 lb-per-yard steel rails, rolled in 30ft lengths and stress-relieved before machining in a vertical gun barrel furnace. The rails were joined by thermit welding, the joints machined *in situ* and laid on rigid chairs designed to transfer carriage loads solidly into the tank walls. In setting up the rails, the use of a water level ensured that the track is parallel to the earth's surface.

To facilitate the investigation of the behaviour of ships in a seaway, a wave-maker, seen in our illustration below, has been installed at the west end of the tank; it consists of a wedge shaped plunger about 17ft high by 7ft wide at the top and extending across the full width of the tank. It is built of steel, the front face being curved to an ideal contour, and is designed to generate waves varying from 40ft, crest to crest, by 2ft, crest to trough, to 5ft by 3in respectively. The 20-ton plunger is moved up and down by two pairs of hydraulic rams automatically controlled by an electronic/hydraulic servo-mechanism, to generate a uniform train of



Electro-hydraulic wave-maker

waves of the frequency and amplitude required. Two air cylinders act as springs to give the effect of ballast in counteracting the buoyancy of the plunger. The hydraulic equipment, as can be seen in our illustration, is built on two concrete plinths and was supplied by Keelavite Hydraulics, Ltd., while Associated Electrical Industries, Ltd.,



Model of 44in water tunnel

was responsible for the electronic control system. Two main circuits operate the pairs of rams moving the plunger, and each is a closed circuit powered by two variable capacity axial piston pumps, each driven by a 40 h.p. motor. These pumps give an oil flow in either direction of between 0 to 110 gallons per minute at pressures up to 1800 lb per square inch, and are synchronised through the servo-system. The oil supply to the pumps is boosted to 250 lb per square inch.

For economic operation and to reduce the time between runs to a minimum it is necessary to damp down water disturbances induced by the model when being towed and also to absorb the energy of the waves. To achieve this there are side and end beaches, provided by J. T. Mackley, Ltd., the former consisting of a continuous length of curved resin-bonded glass fibre flaps hinged to the side walls. The flaps can be raised from their partly submerged still water testing position by lever arms to a vertical position, when waves are being made, to act as splash guards. The end beaches are in three watertight sections bolted together and consist of a 5ft diameter steel tube carrying a curved shelf which forms the beach and extends 5ft below the surface. Timber slats form the part of the beach above the water surface and immediately below it and serve to trap the backwash and so prevent the formation of secondary waves. The beach is partly buoyant and rests on support arms but when not required the supports are retracted and the tanks flooded at a controlled rate to sink to the bottom of the tank. Buoyancy material in the end chambers limits the maximum rate of submersion.

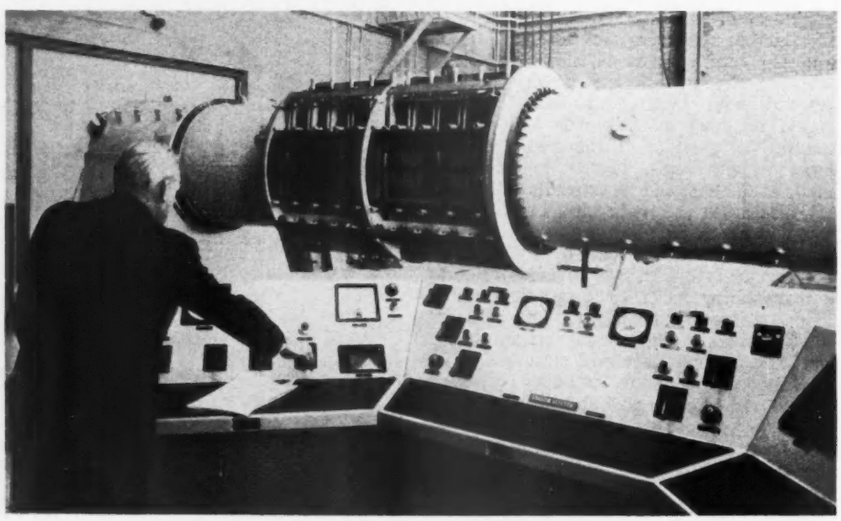
Models up to 10ft in length can be operated in the sea-keeping tank and manœuvring basin which measures 100ft by 100ft and has a water depth of 8ft. The purpose of the tank is to test models in waves at all angles to the ship's course, and in irregular seas and so assess their sea-keeping qualities. The models are free running and operated by remote control and instruments are being developed to measure yaw, pitch, roll, heave, torque and thrust of propellers, rudder angle and torque, and also to track the model. There are two small docks for fitting out and trimming the models, while on the south wall is a continuous triangular plunger pattern mechanically operated wave-maker, built by Hall Engineering, Ltd., capable of producing waves of a frequency and amplitude ranging from 15ft by 9in to 3ft by 3in. The wedge-shaped plunger is 100ft long by 6ft 6in high by 3ft wide at the top and is actuated by a 50 h.p. motor driving a dual line shaft transmission through reduction gearing. At each end of the shafting is an adjustable throw crank and the speed range of the plunger is from 0 to 100 oscillations per minute with a maximum throw of 8in. A beach is mounted on the north wall, and it is planned to fit a wave-maker of articulated design to produce diagonal seas to be superimposed on the main pattern.

The wax model shop contains moulding bins for producing models up to 40ft long and up to 7ft wide, and a large specially designed twin head model cutting machine together with a model finishing area and surface tables for fitting up models. There are four electric wax-melting vats, the wax being pumped to the moulding bins through trace heated pipelines. The temperature of the model shop is carefully controlled, including roof sprays to reduce solar gain. When complete the models are placed in the launching dock and enter the storage area through a gate and then, as required, the models are moved into the transfer dock and lifted by crane to the main tank. The spacious metalworking and woodworking shops are well equipped, and there is a foundry for producing propeller castings, and a propeller machining shop which, when completed, will be able to manufacture model propellers of 24in diameter. At present 12in diameter models in manganese bronze, white bronze, "Perspex" and nylon are being produced. Other services include a laboratory allocated to the study of hull vibration including entrained water effects and shaft vibration.

Water Tunnel

The water tunnel, the arrangement of which is illustrated on this page, has a circular closed throat test section suitable for work on propellers up to 24in diameter, the maximum water velocity in the test section being 50ft per second, while the pressure of the water can be varied from 0 to 6 atmospheres absolute. An alternative working section is planned for the testing of hydrofoils. The tunnel circuit is rectangular and the upper limb of the tunnel, containing the contraction section, the working section and transition and diffuser sections, is at ground level within the laboratory. Two vertical limbs at 87ft centres and a connecting bottom limb, 180ft below the upper limb, complete the circuit and form a resorber. This is of large volume so that the water passes through it at low velocity and, under an additional static pressure head, re-absorbs all the air bubbles which are released into the water stream by cavitation at the model.

In constructing the resorber the shafts and gallery were lined with reinforced



Working section of water tunnel and control console

pre-formed concrete sections, after which the steel pressure shell was lowered into position and welded *in situ*. The mating of the sections had to be accurately carried out since all welds had to be made on the inside.

The 1500 tons of water are circulated by a Vickers-Armstrongs 92in diameter axial flow variable pitch pump which is driven by a vertically mounted English Electric 1062 h.p. d.c. electric motor equipped with an automatic control which holds the speed to 0·1 per cent of any set speed from 14·7 to 147 r.p.m. From the resorber the water flows round a 90 deg. mitred corner through a short settling length, then a contraction section leading to the closed jet working section followed by a transition section before the horizontal diffuser which leads to a 45 deg. mitred corner and the diffuser inclined at 45 deg. and connecting with pump impeller to give the pump a head of 35ft. De-aeration plant provided by Hick Hargreaves, Ltd., is available to condition the water to suit requirements and for this purpose there is a by-pass circuit. For cooling and filtering the water there is a refrigeration plant, supplied by the Lightfoot Refrigeration Company, Ltd., heat exchangers and fine particle filters provided by Metalfiltration, Ltd. It is intended to test model propellers up to 24in diameter and a range of speeds up to 3000 r.p.m. To carry the propellers there is a high tensile steel shaft which is supported in three bearings, the positions of which were selected to suit the whirling characteristics of the shaft. A carefully balanced motor, incorporating a torque dynamometer, capable of delivering 300 h.p. over a wide speed range, drives the shaft. The motor stator is equipped with oil lift bearings and both thrust and torque loads are measured hydraulically. Our illustration shows the working section of the tunnel and the control console.

Lighting of the main tank is by cold cathode tubing mounted in a virtually continuous strip along each wall. The system, developed and supplied by The General Electric Company, Ltd., includes a cut-off which ensures that no light falls directly on the water, thus avoiding undesirable reflections. In the steering pond area lighting is by hot cathode fluorescent units supported from the roof trusses. Heating and ventilating of the main tank building has been designed to maintain dry surfaces and a comfortable level of humidity. The system installed consists of background heating using thermostatically controlled low pressure hot water heating coils in conjunction with a plenum system which introduces warm air from a duct at roof apex level and discharging through grilles at walkway level. The temperature of the incoming air and the volume of recirculated air is automatically controlled to maintain the correct humidity conditions. Two oil-fired Bouellat boilers fitted with Hamworthy burners and burning 750 seconds fuel provide about 7,000,000 B.Th.U. per hour, while a substation handles a demand for 3000kW.

The laboratory was built by the Ministry of Works for the Department of Scientific and Industrial Research and the main contractor was Sir Robert McAlpine and Sons, Ltd., and Thos. W. Ward, Ltd., was the main erection contractor.

The following were the principal subcontractors : Head Wrightson and Co., Ltd. (structural aluminium and steel) ; D. Anderson and Son, Ltd. (roof decking) ; English Electric Company, Ltd. (electrical plant) ; J. Jeffreys and Co., Ltd. (heating and ventilating) ; British Steel Piling Company, Ltd. (sheet piling).

Cantilever Indicator Stand for Precision Inspection*

By D. C. K. PEARCE, A.M.I.Mech.E., and F. R. TOLMON

A simple and robust indicator stand for precision inspection is described. Its principle of operation, as applied to indicator stands, is new and it provides a very fine adjustment by bending the vertical column.

THE scribing block type of indicator stand is generally inadequate for work on which an accuracy of measurement of 0·0001in is required, due to its lack of rigidity and the use of crude methods of adjustment. As long ago as 1942, a much improved indicator stand was designed and constructed in the Metrology Division of the National Physical Laboratory.[1] It was fitted with a fine vertical adjustment of the column, utilising a screw and lever system, and has proved, over the years, to be a very reliable instrument for general surface plate work, to an accuracy of about 0·0001in to 0·000 05in. With the introduction of indicators of higher sensitivity, e.g. 0·000 01in per division, the need has increasingly been felt for an indicator stand of still better rigidity and ease of fine adjustment.

The prototype stand described below was developed in the Standards Division of the National Physical Laboratory to meet this need, and it has the additional advantage that it is very much simpler than previous designs and hence should be much less expensive to manufacture.[2] It is illustrated in Fig. 1. Since the stand has high torsional rigidity about the axis of the column, it can equally well be used to support an indicator with the axis horizontal.

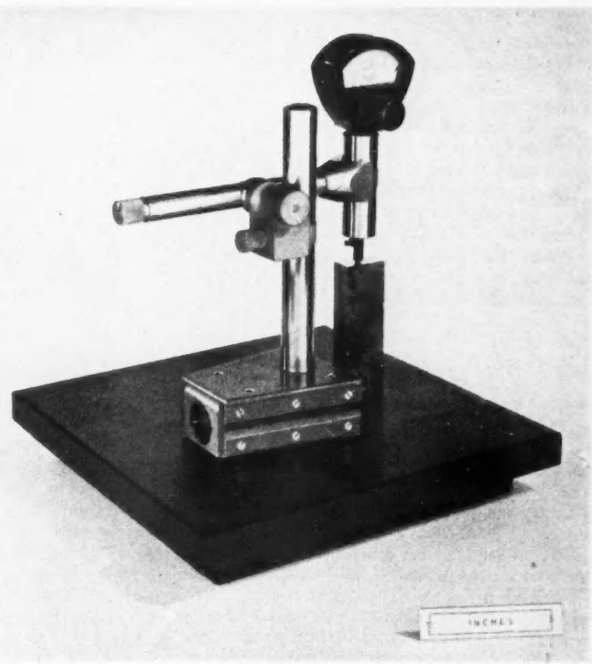


Fig 1.—Cantilever indicator stand for precision inspection. A cantilever and fine screw enable the vertical column to be bent

An important feature of the new indicator stand is the very fine adjustment which can be obtained by bending the vertical column through the medium of a cantilever and a fine screw. This is very conveniently done by making the column in the form of a steel tube, with the cantilever actually inside it, as shown in Fig. 2, which is diagrammatic and not drawn to scale. The lower end of the tubular column is rigidly fixed in the base. The horizontal screw in the base bears on the lower end of the steel cantilever which, at its upper end, is rigidly fixed to the top of the column. By adjustment of this screw, the column can therefore be bent and, in view of the considerable mechanical advantage available, very fine displacements of the column can be attained. The bracket supporting the indicator can be located anywhere along the column so that the sensitivity of the adjustment can be varied, maximum displacement for a given angular rotation of the screw being, of course, obtained when the bracket is at the top of the column. Complete absence of backlash is guaranteed by the use of a limit stop in the adjusting screw, this stop ensuring that the cantilever is always stressed with its free end in forcible contact with the screw. A second stop, fixed within the tube, limits the travel of the screw to one or two revolutions and so prevents the column and cantilever being over-stressed. The base is provided with three supporting pads, and two side locating pads for use in conjunction with a straightedge.

An appreciation of the sensitivity of adjustment which the indicator stand provides may be gathered from the following data :

Length of tubular column	= 8in (20cm)
External diameter of tube	= 1in (25mm)
Wall thickness	= $\frac{1}{8}$in (3mm)
Diameter of (tapered) cantilever at its free end	= $\frac{1}{2}$in (12·5mm)
Diameter of (tapered) cantilever near the top	= $\frac{11}{16}$in (17·5mm)

With the bracket located at the top of the column and the axis of the indicator stylus

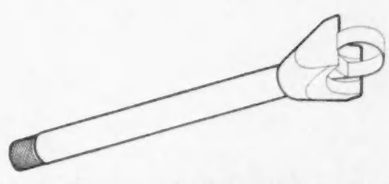


Fig. 2—Diagram to show construction of tubular column and adjustable cantilever

* Communication from the National Physical Laboratory.

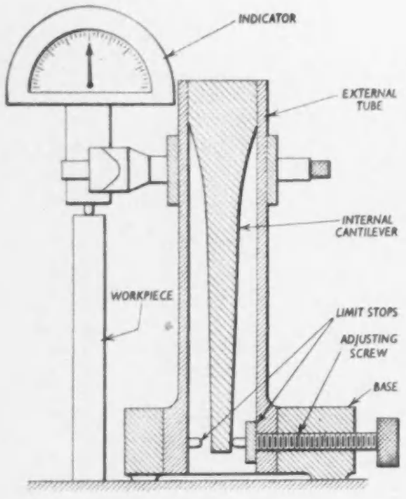


Fig. 3—Adjustable clamp making use of a spring steel band

5in (125mm) from the axis of the column, one revolution of the 40 t.p.i. screw produces :

(i) An angular tilt at the top of the column of approximately three minutes.

(ii) A horizontal displacement of the indicator stylus of approximately 0·003in (0·075mm).

(iii) A vertical displacement of the indicator stylus of approximately 0·0045in (0·1125mm).

When the bracket is lowered so as to be half-way up the column, the horizontal displacement is reduced to about 0·0005in (0·0125mm) and the vertical displacement to about 0·0015in (0·0375mm).

In certain applications, the limited range of fine adjustment which the stand provides might prove to be a disadvantage in that it might prove difficult, when setting up on the work, to bring the pointer of the indicator on scale. When a dial test indicator is being used, various means for making the preliminary coarse setting readily suggest themselves. When the indicator is of the type shown in Fig. 1, the difficulty can be overcome by means of the specially devised clamp illustrated in Fig. 3. The clamp consists of a hollow steel tube shaped at one end to provide a half-cylindrical bearing for the stem of the indicator and a preformed spring steel band fastened to a rod which passes through the tube. The other end of the rod is threaded and engages with a knurled clamping knob bearing on the corresponding end of the tube. The indicator is mounted in the band and pulled into the half-cylindrical bearing by tightening the clamping knob. Under the control of the knob it is easy to obtain a smooth, sliding action which enables the indicator to be accurately positioned and further slight tightening then gives positive clamping. The remoteness of the clamping knob from the indicator is an advantage when space is restricted.

The spring steel band principle has also been applied to provide a universal bracket,[3] enabling the indicator to be locked in virtually any position. Its general construction can be seen from the " exploded " view shown in Fig. 4. The bracket is clamped to the vertical column of the stand by a steel band in a similar manner to that already described for clamping the indicator. The arm supporting the indicator is clamped to the bracket by a steel band unit which is rotatable about the horizontal axis of the clamping screw, hence enabling the arm to be fixed at any angular position in the vertical plane. It is therefore possible by the combination of the two steel band clamps of the bracket to move the indicator to any desired position, good clamping being effected by only two small diameter knobs.

In comparison with the normal kind of bracket used on robust indicator stands, this new design is much lighter, without sacrificing rigidity, and hence maintains better balance of the stand. But perhaps the main advantage of this universal bracket, using spring steel bands, is that the various columns, arms and stems being clamped do not require to be truly cylindrical nor of uniform diameter. Complete interchangeability between different components is therefore achieved without resort to close tolerancing, thereby reducing overall costs.

The work described above has been carried out as part of the Research Programme of the National Physical Laboratory and this article is published by permission of the Director of the Laboratory.

REFERENCES

[1] British Patent No. 575031.
[2] British Patent Application No. 16241/59.
[3] British Patent Application No. 35519/59.

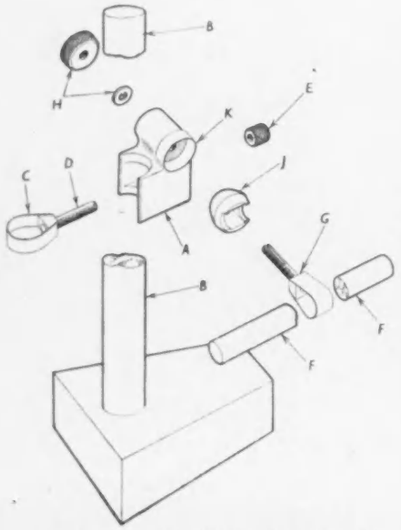


Fig. 4—" Exploded " view of universal bracket

Machine for the Precise Measurement of Internal Diameters*

By I. G. MORGAN, M.A. and F. R. TOLMON

A machine, in prototype form, for precise measurement of internal diameter is described. The machine was developed for confirming the performance of existing machines for diameters up to 6in (150mm) and investigating the possibility of improving upon the accuracy of measurement at present obtained. Comparative tests show agreement between the machines and that an accuracy of ±5 microinches (±0·125 micron) can be obtained. To exploit this accuracy in routine work a final design based on the prototype is being prepared. This further development will include work on the improvement of the reference standard of size employed.

THE continuing demand for higher precision in the engineering industry is nowhere better exemplified than in the field of internal measurement. Whereas before the 1939–45 war an accuracy of ±50 microinches (±1¼ micron)† in the standardisation of reference ring gauges was adequate, except in certain special cases such as the manufacture of fuel injection pumps, it became evident after the war that a higher accuracy was generally needed. To meet the need, the National Physical Laboratory developed two machines which have been described by Taylerson and Turner.[1] These machines, with capacities from 0·1in to 3in (2·5mm to 75mm) and 1·5in to 6in (38mm to 150mm) respectively, use the autocollimator technique adapted for measuring small displacements and their accepted accuracy of measurement is ±10μin (±0·25μm). There is already some evidence that an even better accuracy would be useful in many branches of precision engineering, and more recently attention has therefore been given at N.P.L. to the possibility of attaining this better accuracy by means of the pneumatic gauging technique. It was considered that even though the objective of a higher accuracy might not be realised, it would be valuable to establish an independent technique providing an accuracy comparable to that of the existing machines so that measurements made with these machines could be confirmed. To this end the prototype machine described in this article and illustrated in Figs. 1 and 4 has been built. To save initial expense, use has been made of existing equipment, primarily a Zeiss universal measuring machine, and this has limited the measuring range to diameters between 1·5in and 3·5in (38mm and 90mm). The experience gained with the prototype shows that it will itself provide an accuracy of better than ±10μin (±0·25μm) and indicates every possibility of improving both accuracy and convenience of operation in a final design. Extension of the range to cover sizes from 0·25in to 6in (6mm to 150mm) should present no problem in the design and construction of the final machine.

* Communication from the National Physical Laboratory.

†Hereafter, for convenience, the symbols μiu for microinch, and μm for micron will be used.

The Principle Employed

The diameter of the ring to be measured is established by comparison with the known size of a reference standard of box form[2] built up from slip-gauges and lapped steel end-plates as shown in Fig. 2. The method by which the comparison is made is shown diagrammatically in Fig. 3. The ring and standard are placed side by side on a rigid traversing carriage. Two ball-ended styluses pivoting in bearings set in a fixed mounting above the table engage, one with the ring and one with the standard, and movement of these styluses is measured by sensitive indicators. Let the diameter of the ring be R, the known size of the standard S, and the diameters of the stylus balls engaging with ring and standard b_R and b_S respectively. The traversing carriage is first positioned so that the styluses contact the ring and standard as shown in Fig. 3(*a*). In

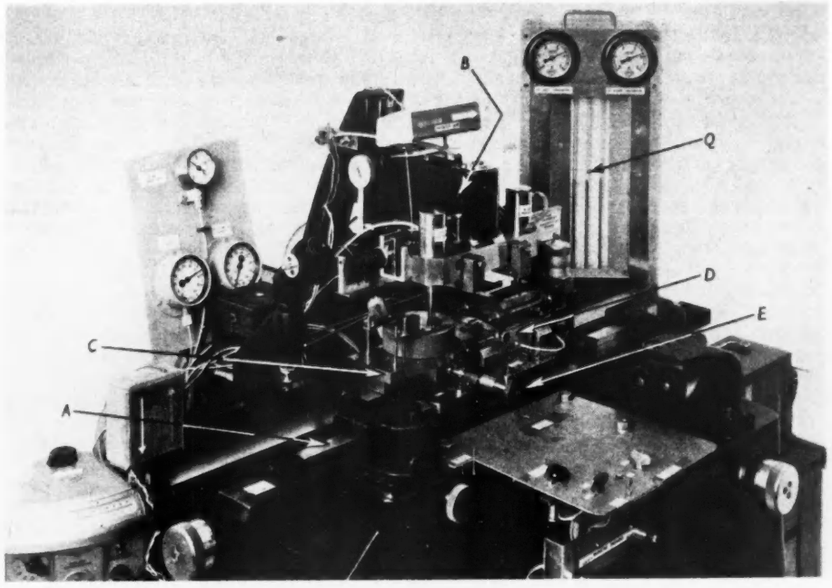


Fig. 1

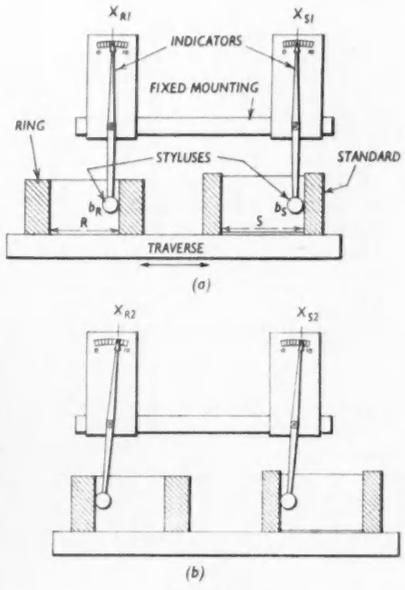


Fig. 3

this position, let the indicator reading for the ring stylus be X_{R1} and the reading for the standard stylus be X_{S1}. The carriage is then traversed so that the styluses contact the opposite sides of the ring and standard as shown in Fig. (3*b*) and in this new position let the corresponding indicator readings be X_{R2} and X_{S2}.

If the movement of the carriage is L, then

$$L = R - b_R - (X_{R2} - X_{R1}) = S - b_S - (X_{S2} - X_{S1}).$$

Thus,

$$R = S + (b_R - b_S) + (X_{R2} - X_{R1}) - (X_{S2} - X_{S1}),$$

and as the terms on the right-hand side of this expression are known the value of R may be calculated.

As the terms on the right-hand side may be regrouped to read

$$R = S + (b_R - b_S) + (X_{R2} - X_{S2}) - (X_{R1} - X_{S1}),$$

the procedure can be simplified by using a

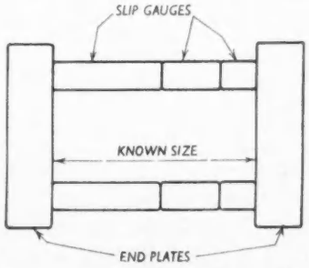


Fig. 2

differential indicator which records $(X_{R2} - X_{S2})$ and $(X_{R1} - X_{S1})$ directly. This is in fact done, as will be described.

The Measuring Equipment

To try out the method the equipment illustrated in Fig. 1 was built up on an existing Zeiss universal measuring machine. This machine is equipped with a traversing carriage *A*, having provision for fine adjustment and clamping in any desired position, and an overhanging head *B* which may be adjusted vertically and clamped in any desired position. Of the various facilities provided by the Zeiss machine these two alone are employed and others seen in Fig. 1, e.g. measuring microscope and scale, are not used. The massive and rigid construction of this machine makes it very suitable for the present work but a machine designed specifically for this work could be made much more compact.

Two auxiliary tables *C* and *D*, carrying the ring and standard respectively, are mounted on the main carriage *A*. The surfaces of these tables are parallel to the plane of motion of the carriage. Table *C* can be traversed in a direction at right angles to the direction of motion of the carriage *A*. (To distinguish between these directions the former will be called the lateral direction and the latter the longitudinal direction.) The lateral traverse of *C*, accomplished by means of a leadscrew operated by the knob *E*, enables the ring to be so positioned that when the carriage *A* is traversed the points of contact of the measuring stylus with the ring lie on a diameter. For this purpose it is essential that the motions of *C* and *A* are accurately at right angles to one another and the necessary adjustment was made and checked during assembly. The inherent stiffness of the leadscrew system is sufficient to maintain the table *C* in a set position and there is no additional provision for clamping this table. When placed on table *C* the ring embraces a ball-ended pin protruding upwards from the table and is pressed against this pin by a movable V-shaped abutment which contacts the external surface of the ring. This abutment is marked *F* in Fig. 4. The combination of pin and abutment immediately locates the ring in an approximately correct position with respect to the stylus so that the final setting for measurement may be quickly and conveniently achieved.

Table *D* can be traversed over a short range in the longitudinal direction independently of the carriage *A*. This traverse provides for the necessary adjustment of the relative positions of the ring and standard in the longitudinal direction so that both stylus indicators may be separately zeroed. (This could also be accomplished by providinstead for relative adjustment of the stylus mountings and the choice of method was purely a matter of convenience.) The motion of *D* is controlled by a screw-driven wedge permitting very sensitive adjustment

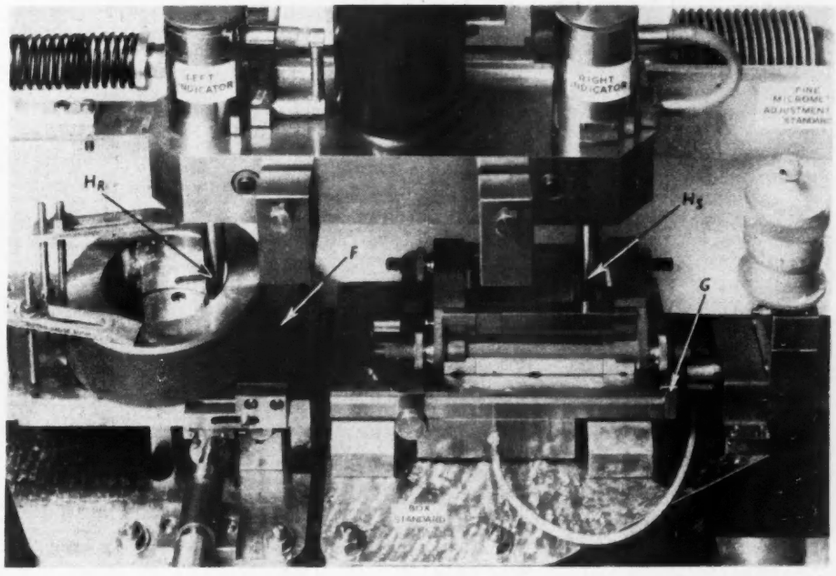


Fig. 4

and the table can be fixed in any desired position by means of a pneumatically operated clamping device. The reference standard rests on table *D* with one of its end-plates in contact with an abutment, marked *G* in Fig. 4, which takes the form of a straight-edge set accurately at right angles to the direction of motion of the carriage *A*. This abutment serves to position the standard so that the known reference dimension, i.e. the perpendicular separation of the end-plates, is parallel to the longitudinal direction.

The measuring styluses are seen in Fig. 4 marked H_R and H_S. Fig. 5 shows diagrammatically the construction of the stylus unit.

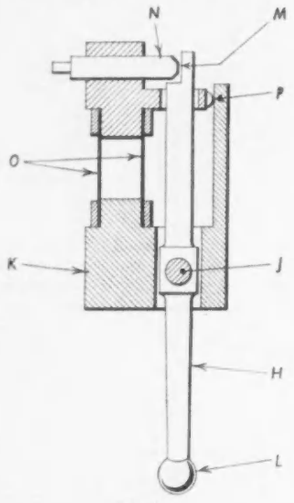


Fig. 5

The stylus arm *H* pivots at its mid-point on a spindle *J* carried by precision ball-bearings mounted in the body *K*. These bearings are pre-loaded and carefully adjusted during assembly so as to eliminate lost motion whilst retaining friction-free rotation. At the lower end of the arm is the ball *L* which contacts the ring or standard and at the upper end is a flat lapped face *M* against which compressed air issuing from the jet *N* impinges. Movement of the ball causes the arm to swing thus moving the lapped face in relation to the jet. The clearance between *M* and *N* is therefore determined by the position of *L*. The jet *N* is incorporated in a conventional pneumatic gauging circuit so that movement of *L* may be displayed at a high magnification by an instrument responsive to the change in air pressure which results from a change in clearance at the jet. (The pneumatic gauging technique is well known and has been described in detail elsewhere.[3])

Since the clearance between the jet *N* and the lapped face *M* is small (0·004in (0·1mm)) they will be brought into contact if the stylus is accidentally "over-run" during a measurement. To prevent damage to either, the jet mounting is supported on flexible steel strips *O* so that an "over-run" merely carries it away from the locating abutment *P*. A simple arrangement of leaf springs attached to the arm *H* enables the stylus to be biased, in turn, in either of the two directions necessary for contact with the opposite sides of the standard or ring by the operation of a throw-over lever.

The pressure responsive instruments used are differential liquid manometers‡ marked *Q* in Fig. 1. The arrangement of the pneumatic circuits is shown diagrammatically in Fig. 6. Compressed air is fed from the pressure regulator *T* to the manifold *U* from which the jets N_R and N_S are supplied via the control orifices V_R and V_S. The pressure existing between N_R and V_R is fed to one side of the differential manometer W_D and the pressure between N_S and V_S is fed to the other side of W_D. The reading of W_D is thus proportional to the relative movement of the styluses within the range over which the displacement/pressure characteristic of each is linear and their sensitivities the same. Were the linear range large then the manometer W_D would alone be sufficient for carrying out the measurement but as this range is in fact restricted it is necessary to provide means of ensuring that each stylus is operating within prescribed limits. For this purpose the manometers W_R and W_S indicate independently the individual pressures in the measuring circuits. W_R and W_S are also differential manometers and their balancing pressures are obtained by means of subsidiary circuits comprising escapement valves *Y* in association with control orifices *Z*. The valves *Y* are initially adjusted so that W_R and W_S are balanced when the stylus units are set to the mid-points of their respective working ranges. The balancing pressures thenceforward provide pressure datums for setting the system in the process of measurement, the positions of the ring and standard being so adjusted that the readings of W_R and W_S lie inside the limits necessary to ensure that the differential pressure readings of W_D are within the linear range. With proper design and initial adjustment of N_R, N_S, V_R and V_S these limits are such that there is no practical difficulty in achieving the necessary settings.

Incorporated in the machine are several ancillary devices which facilitate setting up and operation. These include a pneumatically operated device for changing the direction of bias of the styluses, relay operated signal lamps to indicate the direction of bias and the corresponding direction of motion of appropriate adjustment controls, pneumatically operated clamps and various additional pressure gauges. It is felt however, that there is no object in discussing these items in detail as in most cases they represent convenient use of already available components rather than the most efficient designs for their respective functions.

It will be useful to note some numerical values relating to the various components of the machine. The constant supply pressure to the pneumatic measuring circuits, i.e. the output from the regulator *T* in Fig. 6 is 5 lb per square inch (0·35 kg per square centimetre) and the mean value of the operating pressure between the jets and control orifices is 3·7 lb per square inch (0·26kg per square centimetre). A stylus displacement of 0·001in (25μm) gives a change in indicator liquid level of 10in (25cm), so that the overall magnification is 10,000, which was considered suitable for the trial of the method. (The precision of the prototype indicates that a higher magnification could be employed with advantage and it is intended to increase the magnification to 30,000 in the further development of the machine.)

As mentioned earlier, the differential reading of the indicator W_D is only valid when the individual styluses are positioned within prescribed limits. The displacement/pressure characteristics of the two measuring circuits are so matched that it suffices to set and reset either W_R or W_S to within ±0·5in (±12·5mm) liquid level displacement about the centre scale reading. The appropriate fine adjustment controls permit setting of the liquid level within ±0·1in (±2·5mm) with ease and during all test measurements setting to these closer limits was carried out as routine.

The alignments of the various traverses and abutments are toleranced on the basis that errors in these alignments should not individually introduce systematic errors of measurement exceeding 1μin (0·025μm) for rings up to 6in (150mm) diameter. Calculation showed that :

(*a*) The direction of lateral motion of table *C* should be at right angles to the direction of motion of the carriage *A* to within 0·0005in per inch.

(*b*) The straight-edge abutment on table *D* should be so aligned that the working faces of the end-plates of the reference standard lie at right angles to the direction of motion of *A* to within 0·0005in per inch.

(*c*) The surfaces of the tables *C* and *D* should be parallel to one another and to the plane of motion of *A* within 0·0005in per inch. (This tolerance has meaning only if it is assumed that the support faces of the standard end-plates are appropriately square to the working faces and that the end-faces of the ring are likewise square to its axis. The former can be controlled in manufacture of the end-plates but, for a ring selected at random, the latter requires checking if not independently guaranteed.)

These tolerances were easily achieved in the construction and assembly of the equipment and the measured misalignments do not in fact exceed 0·0001in per inch for (*a*), (*b*) or (*c*).

The contact load of the measuring styluses is 10 g weight ±1 g weight for both styluses in either direction of bias. At this load the combined effect of elastic compression and bending of the styluses is appreciable (theoretical calculation gives about 7μin (0·3μm), but as the effect is substantially the same in both ring and standard it is considered unlikely that it introduces a systematic error in excess of 2μin (0·05μm).

The styluses used in the performance tests so far undertaken comprise 0·5in (12·5mm) diameter lapped steel balls soldered to

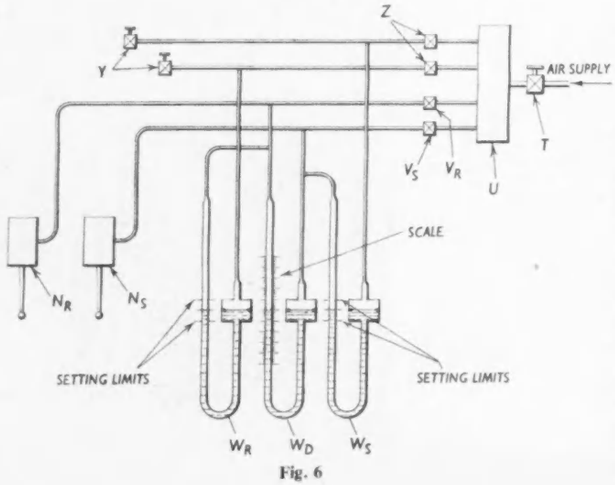


Fig. 6

‡Liquicolumn units manufactured by the Sigma Instrument Company, Ltd.

tapered steel arms, the centre of each ball being nominally 3in (75mm) from the pivot. The balls were carefully selected for sphericity and finish but differed in diameter. This difference in diameter must be precisely known and was initially measured in a Sears comparator, the value obtained being 53μin $\pm$3μin (1·35μm$\pm$0·07μm). In the course of the tests it soon became apparent that the performance of the machine was such that this accuracy was scarcely adequate and the good repetition of results obtainable suggested that the machine itself offered the best means of determining the difference in diameter of the balls. This was done by comparing two reference standards, one being placed on table D and the other on table C in the position normally occupied by the ring. By transposing the standards from one table to the other and repeating the comparison the actual sizes of the standards were eliminated in the calculation of the difference in diameter of the balls. The value obtained was 53μin (1·35μm). A particular advantage of this method of determination is that errors due to compression and bending of the stylus and relative movements of the supporting tables due to distortions which may occur when the carriage is traversed are included in the results and thus automatically taken into account in the measurement of a ring. The value determined, although treated as the difference in diameter of the balls, is therefore more properly a " constant of the machine." The fact that this value agrees precisely with that given by the Sears comparator merely shows that the cumulative effect of errors due to the sources mentioned above is in fact negligible. In the light of this agreement, the factor b_R-b_S in the formula for calculating the ring size is taken to be 53μin$\pm$1μin (1·35μm$\pm$0·025μm).

The Measuring Procedure

The procedure for measuring the diameter of a ring is as follows. The ring is placed on table C so as to embrace the locating pin and is pushed into contact with this pin by the V-shaped abutment before being lightly clamped in position with suitable finger-clamps. A reference standard of the same nominal size to within 0·0001in (2·5μm) is placed on table D and held in contact with the straight-edge abutment by a spring loaded plunger. The styluses are lowered into the ring and standard with the bias of each stylus set, say, to the right. The carriage is traversed so that the styluses make contact at the right-hand sides of the ring and standard and the manometer liquid levels are on scale. The settings of the locating abutments are such that, for convenience, all three liquid levels are immediately on scale simultaneously. The lateral traverse of table C is now adjusted so that the reading of tube W_R is a maximum, in which position the stylus is contacting the ring at one end of a diameter parallel to the direction of motion of the carriage. (Whether a maximum or a minimum is sought depends on whether contact is made on the left or right and on the chosen arrangement of the pneumatic circuit.) The carriage is then adjusted so that the reading of W_R lies within the prescribed setting limits mentioned earlier. The fine adjustment control on Table D is next employed to bring the standard into such a position that the reading on tube W_S is also within the setting limits, when W_D will indicate a reading near to the centre zero of the scale. The reading on W_D which is $X_{R1}-X_{S1}$, is noted. The stylus bias is now reversed and the carriage traversed so that contact is made on the left-hand sides of the ring and standard and the reading on W_R again lies within the setting limits. The new reading on W_D, which is $X_{R2}-X_{S2}$, is noted and the size of the ring can now be calculated from the relationship

$$R=S+(b_R-b_S)+(X_{R2}-X_{S2})-(X_{R1}-X_{S1})$$

It may be observed that, if desired, the fine adjustment control of table D may be used to set

$$(X_{R1}-X_{S1})=(b_R-b_S)$$

If this setting is made then,

$$R=S+(X_{R2}-X_{S2})$$

and the second reading on tube W_D gives the difference in size between the ring and standard directly.

Performance Tests

Performance tests were carried out with the machine installed in an air-conditioned room with ambient temperature controlled at 20 deg. Cent. After placing the ring and reference standard on the machine a minimum period of two hours was allowed to elapse before making measurements so that the ring and standard, heated by handling, could settle down to a common steady temperature. Measurements were made only when the room temperature had remained constant within $\pm$0·1 deg. Cent. during this period.

The repeatability of the machine was first established using a 2in (50mm) diameter ring and corresponding standard. The carriage was repeatedly traversed, without disturbing either ring or standard, and observations were recorded as described earlier. These observations showed repeatability to within 2μin (0·05μm), i.e. to the limit of " readability " of the scale at 10,000 magnification. Further tests were then made in which the ring and standard, either separately or simultaneously, were repeatedly removed from the machine and replaced, so that the various machine adjustments had to be reset between observations. Over a protracted trial it was established that the results were reproducible to within 4μin (0·1μm).

The tests were next extended to include breaking down and re-assembling the reference standard between measurements and it was also convenient at this stage to introduce comparisons with the two autocollimator machines.[1] Several rings with diameters in the range from 1·5in to 3·5in (38mm to 90mm) were measured on the new machine and on one or both of the autocollimator machines. For each size the same slip-gauges were used in the standards for all three machines. The tests showed that with adequate care to ensure proper wringing together of the slip-gauges and end-plates there was no significant variation in size of the reference standard on repeated breaking down and re-assembly. For a given ring each machine gave results reproducible within $\pm$5μin ($\pm$0·125μm) and the mean values of the separate sets of observations on the different machines agreed to within 5μin (0·125μm).

Further Development

The results of the tests described above represent a very satisfactory performance of the prototype machine and also indicate that the autocollimator machines are capable of a greater precision than hitherto realised. One object of the present work, namely the confirmation of the reliability of the autocollimator machines, is fully achieved. It is also clear that an accuracy of better than $\pm$10μin ($\pm$0·25μm) can be obtained with either technique. For routine work the pneumatic machine is more convenient to use than the autocollimator machines, particularly as its readings are directly displayed on an open scale as opposed to being obtained from the setting of an optical micrometer eyepiece. A design is being prepared for a machine with a magnification of 30,000 and a nominal capacity from 0·25in to 6in (6mm to 150mm) with provision for possible extension of this range down to 0·1in (2·5mm).

Attention will also be paid to improvement of the reference standard. As has been mentioned earlier, the present form of box-standard is capable of high precision but this is dependent on careful assembly involving considerable handling of the slip-gauges and end-plates and resulting in appreciable rise of temperature. It may require several hours after assembly for the standard to reach an equilibrium temperature equal to that of the ring and this seriously limits the amount of work which may be carried out on a single machine. In order to provide a standard which can be assembled by a relatively unskilled operator and with a minimum temperature rise it is hoped to replace the slip-gauges at present separating the end-plates (Fig. 2) by a solid U-section member forming a firm basic element to which the end-plates may be wrung quickly and easily. With such members made in nominal sizes at say, 0·5in (12·5mm) intervals any desired reference size can be obtained by wringing slip-gauges to the inner face of one end-plate. The usefulness of such standards will depend on the ease with which the U-section members can be manufactured with the requisite flatness and parallelism of their end-faces and with sufficient stability for initial accuracy to be maintained. A 3in (75mm) prototype has been successfully made and a 6in (150mm) size is at present being made for further trials.

Finally, it is considered that with the higher magnification machine now being designed it may well be possible to compare the ring and standard with such accuracy that uncertainty in the accepted size of any form of standard comprising several separate components wrung together would be a principal source of uncertainty in the absolute accuracy of measurement. With this in mind the design for the new machine will provide for the attachment of an interferometer which may be used to measure directly, *in situ*, the size of the standard with which the ring is compared.

Acknowledgments

The authors have been much assisted by the advice and encouragement of Dr. J. C. Evans, who first suggested the possibility of using a pair of pneumatic indicators in the present application. As the performance of the machine depends so much upon the precision of the indicators the authors would also like to acknowledge the assistance given by Mr. J. E. Furse, who undertook their detailed design, and by Mr. J. R. Boxall, whose skill in constructing them has contributed greatly to their success.

The work described above has been carried out as part of the research programme of the National Physical Laboratory and this article is published by permission of the Director of the Laboratory.

References

[1] Taylerson, C. O. and Turner, A., *Proceedings of Symposium on Engineering Dimensional Metrology*, page 73, London. H.M. Stationery Office, 1955.
[2] *Ibid.*, 1.
[3] Evans, J. C., *Journal Institution Production Engineers* (1957), 36, 110.

Mainly Metallurgy

by T. Henry Turner, M.I.Mech.E. M.I.Loco.E. A.R.Ae.S. F.I.M.

Research Laboratories for Tube Investments, Ltd.

Ten miles south of Cambridge, near Duxford Airport, Tube Investments, Ltd., has now brought into full use a new block of research laboratories at Hinxton Hall. On September 28 fifty visitors, many of whom were representatives of the Press, were welcomed there by Sir Ben Lockspeiser, Director of the T.I. Research and Development Division. Dr. T. P. Hughes, Director of the Laboratory, explained the arrangements for the visit in a well-furnished lecture room on the first floor.

Tube Investments, Ltd., first formed a research and development department in Birmingham in 1929 and recollection of the " Black Country " conditions in which the staff worked thirty years ago made the clean air and sunshine at the new laboratories notably welcome. Many of the visitors commented at once on the clarity of the atmosphere and the cleanliness of the buildings and surroundings in this pleasantly wooded countryside. Over the years, the T.I. group of companies has grown until it now includes seventy different firms. It also owns or collaborates with overseas subsidiary and associate companies in Argentina, Australia, Canada, India, New Zealand, South Africa and Southern Rhodesia. These businesses employ scientific staff who handle in works laboratories the many day-to-day specific, *ad hoc*, questions.

But about ten years ago the management decided that a much greater interest would need to be taken in long-term research, no doubt influenced by the revolutions in thought and practice brought about by developments in nuclear energy and gas turbines. The new laboratories at Hinxton Hall therefore form a part of a very large planned expansion of research and development facilities, which also include four other establishments, respectively, a technical centre at Walsall ; a department of technical information at Birmingham ; a computer unit at Walsall ; and an operational research unit at Birmingham. It was not until 1954 that Hinxton Hall was acquired to act as the centre for the new research laboratories, which are intended to provide the scientific basis for much development work, and also to help forward fundamental research in the fields of science which are of especial importance to the T.I. group of companies. While these fine new research laboratories were being built near Cambridge for fundamental studies, the T.I. group was also building up the technological centre at Walsall. The main function of the latter is to research into and develop process engineering, reducing costs, improving quality, and introducing new products. It helps the development departments of the manufacturing companies with their current problems in production and development.

The total staff of the T.I. Research and Development Division now exceeds 450, and of these about 150 work in the new laboratories at Hinxton Hall, where the visitors were given an opportunity of seeing some of the promising lines of research and of discussing them with the senior scientists in each of the numerous sections.

Most of the products of T.I. companies will be made from carbon steels but they also make tubes from stainless steels and from alloys of titanium, zirconium, tantalum, niobium, vanadium, and from pure molybdenum. Special tubes are also made from nickel, Inconel and the Nimonic series of alloys, and from many other non-ferrous alloys. The recent inclusion of the British Aluminium Company, Ltd., into the T.I. group has strengthened research facilities in the field of aluminium by making available the already well-known laboratory facilities which had been built up by the British Aluminium Company at another country mansion in Chalfont Park, Gerrards Cross, Bucks. Tube Investments group of factories throughout England and Wales divide primarily into divisions for steel tube, engineering, cycle, aluminium, iron and steel, general, electrical and nuclear energy—so the fields for research are many and large.

The New Laboratories

Research work started in the old Hall at Hinxton (Fig. 1) in 1954, and the new laboratories (Fig. 2) were built nearby in 1956–58. Most of the research activities have now been transferred to this building, leaving the old Hall to accommodate the library, conference rooms, administrative and technical services. The total area of the new buildings is 32,500 square feet, on three floors. Here the basic scientific work is done for the T.I. companies. In making tubes, metals undergo hot and cold deformations ; research must therefore deal with the properties of the materials, having in mind that metals are many times weaker than they should be according to theory.

The following items of research were shown to the visitors :

Electron microscopy of very thin metal films has been used to study the atomic processes occurring during the deformation of a wide variety of metals. The two electron microscopes here used have already provided remarkable practical confirmation of the metal physicists' theory of metal deformation in terms of the movement and interaction of crystal lattice defects. Mechanical properties of non-metallic " whisker " crystals are being studied because although glass and ceramics are normally brittle solids they may show the highest strengths so far recorded when in the form of extremely thin " whiskers or fibres," e.g. about 1000 tons per square inch tensile strength for " whiskers " of aluminium oxide and silicon carbide. A film showing the growing of such fibres fascinated the visitors.

Lubrication and wear present obvious problems in the cold drawing of metals through dies. A research team is therefore using radio-tracer techniques to study

Fig. 1—Hinxton Hall, the old hall has now become the administrative building

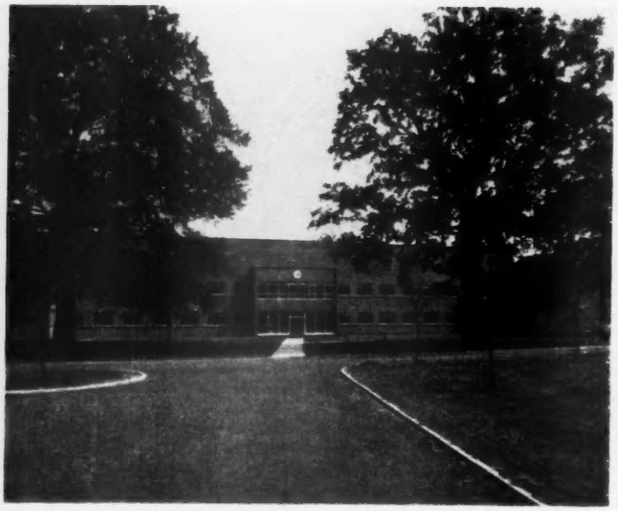


Fig. 2—The newly-established block of research laboratories at Hinxton Hall

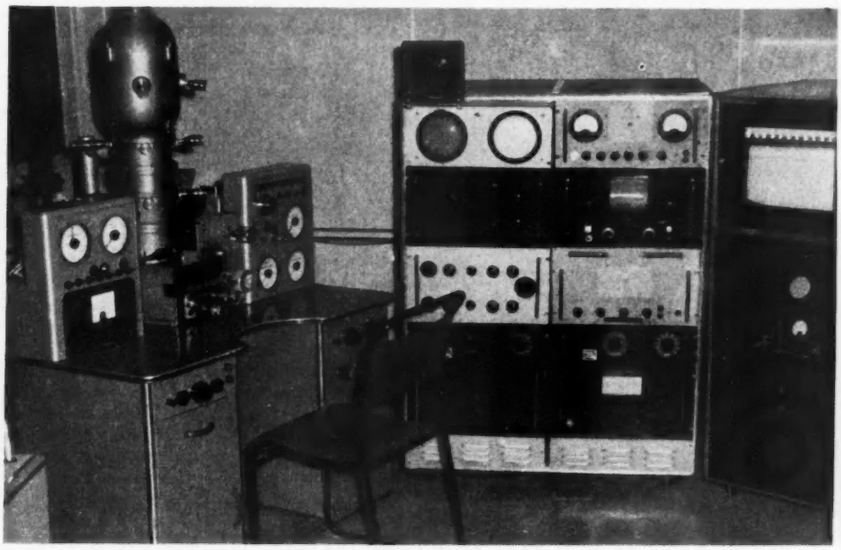


Fig. 3—Micro-analyser equipment in use at Hinxton Hall. It is a new and powerful tool for metallurgists

the wear of tungsten carbides. It has found that the wear is steady and not erratic as had previously been supposed. This research should prove to be valuable to many tube-making plants.

Resistance welding and ultrasonic welding are both being studied in novel manners. If it proves possible to be certain about the geometry of current flow patterns in the metal being welded, more economical and reliable resistance welds, and indeed flash butt welds, should eventuate.

Two basic studies were shown to the visitors to illustrate the influence of impurities on metal deformation. It is known that residual elements such as copper, tin, nickel, which find their way into steel ingots as more and more scrap is used in the world's steel furnaces, affect the workability of the metal. During the essential reheating operations oxidation occurs and these so-called "tramp" elements segregate at the steel surfaces during the preferential oxidation. The new X-ray scanning micro-analyser is being used to study this process.

Commercially pure beryllium is being examined with the aid of the metallurgical microscope and a precipitation phenomenon has been revealed. This work may lead to new techniques for making tubes of this unusually intractable metal, which interests the designers of high-temperature gas-cooled nuclear reactors and certain missile and aircraft components.

Corrosion studies are a relatively new section of the work, but they have become still more essential since stress corrosion is not understood in detail and can be a serious problem with heat exchangers. The stress-corrosion crack penetrates in steps; the alloy's structure and state of strain playing important parts, as shown by optical and electron micrographs. There is no absolute scale of corrosion resistance. The relative performance of alloys is different in each environment. It is now sought to learn the conditions under which protective oxide films are stable.

High-energy irradiation induces chemical reactions and research is being conducted to determine the scope of this technique in chemical synthesis and fabrication processes. Radiation can induce reactions in fabricated shaped objects, which may be a boon to certain manufacturers but, perhaps, a new threat as a subtle means of sabotage.

The demonstrations using "Plasticine" models, in an attempt to establish the causes of off-axis punch drift in the punch piercing process of tube making, were easily appreciated and would have been much enjoyed by any scientifically minded person. Similar model experiments gave one a fuller understanding of cross rolling techniques for rotary piercing and elongating operations in tube making.

Two new instruments of great interest were demonstrated. The X-ray scanning micro-analyser (Fig. 3) designed by the T.I. scientists specifically for work on metallurgical problems, derives from a prototype developed at the Cavendish Laboratory, Cambridge, and promises to be a powerful tool for metallurgical research. An electron beam is focused to a diameter of less than one micron and caused to scan the surface of the specimen in a similar manner to the beam in a television tube but rather more slowly. On the screen a picture is "painted" of the distribution of the element selected over the area scanned. Point quantitative analyses and a linear distribution display are also possible. It is not yet able to analyse carbon and silicon and the light alloys but is already very useful for all the metals heavier than magnesium.

The second instrument of novel design was appropriately the tube eccentricity meter and screening micrometer. Tube wall thickness variations are assessed by their electrical screening effect. Arising out of this work a remarkably sensitive micrometer device has been developed at Hinxton. Its versatility is such that it can be used to study movements of $\frac{1}{2}$in or a few millionths of an inch.

International Research on Blast Furnaces

In all the major countries where steel is made the blast furnace, which smelts iron ore into pig iron, is the essential first step in the process of manufacture. The greatest economic yield of pig iron now comes from exceedingly costly furnaces, which are often 100ft in height. But in all these steel-making countries increasing difficulty is being experienced in obtaining regular supplies of metallurgical cokes, which must be strong enough to withstand the weight of the increasingly high columns of fuel, ore, and flux, in these high furnaces, without crushing to powder and so blocking the free upward passage of the blast and of the essential ore-reducing gases. In 1951 there came about as a consequence the co-operation of interested organisations from no less than six different countries, namely: Austria, Belgium, France, Greece, Italy and Holland.

Later these organisations were joined by the Batelle Memorial Institute of the U.S.A., and Great Britain participated as an associate. Specialists from Germany, Sweden, Switzerland and Jugoslavia agreed to take part as consultants to the committee.

The original members assured the costs for five years; some then did not desire to renew their commitment but the European Community for Coal and Steel (C.E.C.A.) agreed to assure about half of the budget for three years, and the Belgian and French Industrial Research Authorities (I.R.S.I.A. and I.R.S.I.D.) also stepped in to help for the same period. All this international co-operation has permitted continuous research on a "low furnace" erected near to the normally designed "high furnace" blast furnace plant of the S. A. Cockerill–Ougrée at Liège, in Belgium.

A report (No. 23 "Travaux du Comité International des Recherches sur Le Bas Fourneau, Belgique—C.E.C.A.—France") on some of this research has now been published. It relates to work carried out during 1958.

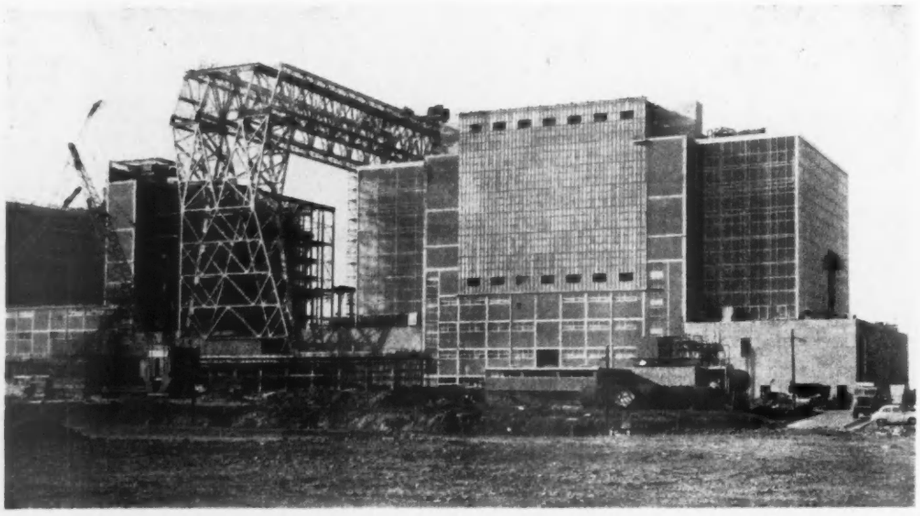
At first the experimental "low furnace" was used to study the behaviour of raw materials, which gave trouble in ordinary high blast furnaces, on producing pig iron. It was found that the low furnace could use fuels having lower mechanical strength than the classical metallurgical cokes. Even bituminous coal could be used, although the by-products spoilt the gas washing water, a matter which could be remedied if needed. The low furnace was able to handle much smaller pieces of minerals but when the size became smaller than 5mm operation became troublesome. Above a certain blast intensity the charge in the furnace became fluidised because of the small size of its constituents and caused irregular down flow and such excessive carry over of dust as to prohibit the operation.

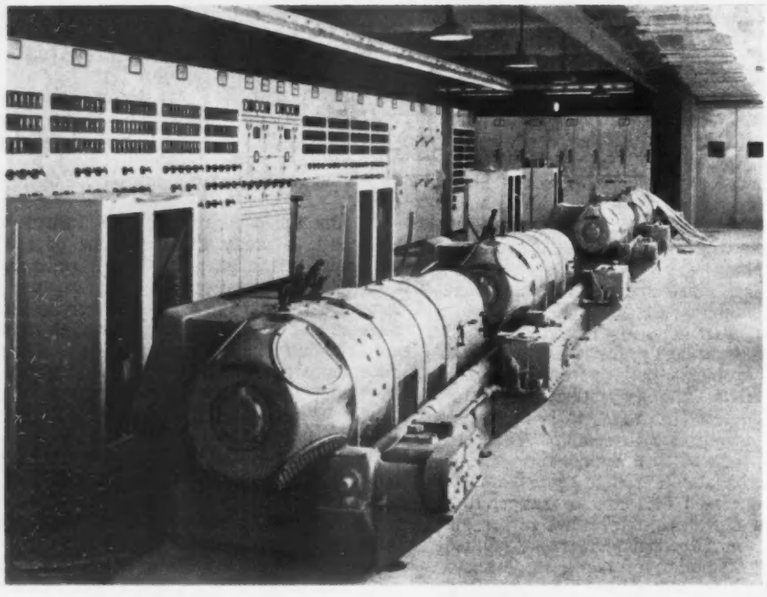
The appearance of such phenomena, which were expected, was investigated stage by stage using the addition of oxygen to the air blast, its humidification, the employment of high temperatures, counter pressure, and the addition of liquid fuel. Each of these additions was tested separately. It was concluded that the low furnace would suffer in Europe from the handicap of increased labour requirement, as compared with modern high blast furnaces. In undeveloped countries where the great cost of big blast furnaces could not yet be envisaged, the low furnace producing 100–200 tons of pig iron a day may prove to be the ideal plant, while the metallurgical industries are growing up.

However that may be there can be no doubt that this international experimental low shaft furnace offers a means of carrying out quickly, on a pilot plant basis, many tests which would take much longer on high blast furnaces; indeed they would be too costly and would interfere with the operation of steel works and mills if so attempted. During 1958 experiments have therefore been conducted on the Liège low furnace considering it as an experimental high blast furnace, for which pilot plant purpose it has been found to be perfectly adapted.

Progress at Bradwell

The last of the twelve boiler shells for Bradwell nuclear power station was landed at Bradwell Waterside on October 12, after being towed by sea from the Thornaby-on-Tees works of Head Wrightson and Co., Ltd. This operation followed the same pattern as that used for the previous eleven boiler shells, as described in our issue dated May 23, 1958, page 772. Each shell is a vertical pressure vessel of 1 $\frac{9}{16}$ in plate, 19ft diameter, increasing with a transition piece, to 20ft diameter at the base; the overall height is 92ft 4$\frac{1}{2}$in and the weight 200 tons.

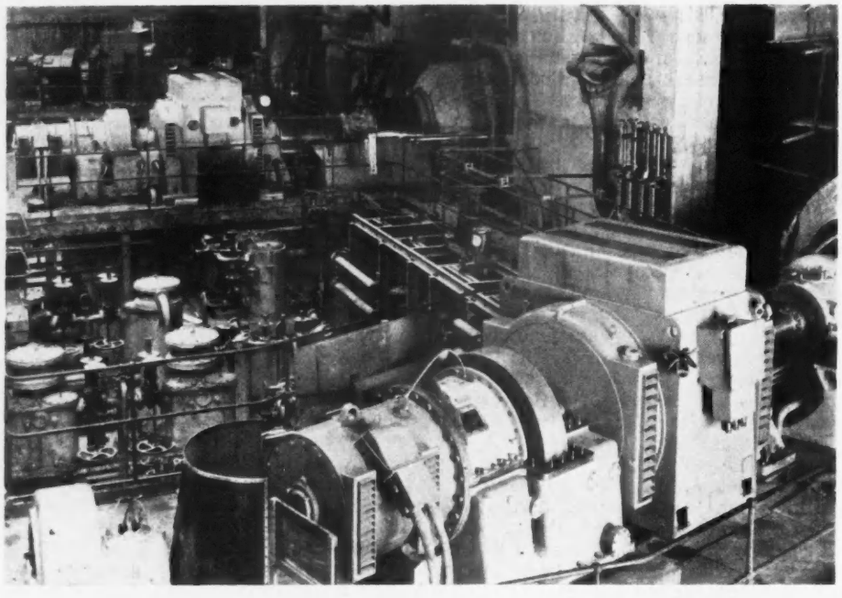




No. 1 reactor is due to reach criticality towards the end of next year and the two-reactor station, with its net electrical output of 300MW is due to be completed by the end of 1961. Apart from minor details the building for No. 1 reactor is complete, as illustrated ABOVE. The spherical pressure vessel for this reactor has been stress relieved after welding on site and is ready for the pressure test, after which the standpipes for the reactor charge and control system will be installed. Clean conditions will then be established inside the vessel in preparation for the laying of the graphite core. In the pile cap area above the vessel the gantry for the charge/discharge machine is in position on its rails. The pile cap crane is installed.

Five of the six boilers (three at each end of the reactor) are fully tubed and the sixth is nearly complete. There is a blower house at ground level, below each group of three boilers and five of the six blowers for No. 1 reactor have passed their "phase 1" or running test; a general view of a blower house is reproduced BELOW. The burst slug detection equipment and the upper control rod gear are installed in the reactor control rooms. Some of the electrical equipment for the drives of the groups of control rods is illustrated LEFT.

On No. 2 reactor the top cap of the pressure vessel will be lifted and welded in position early next month. Tubing is in progress on five of the six boilers. The gantry for the charge/discharge machine is to be installed in the next few weeks. A cooling pond is being built for the temporary storage of irradiated fuel elements from both reactors; the civil engineering works which can be seen in front of the reactor building in the TOP ILLUSTRATION are about 85 per cent complete. The turbine house is structurally complete. In the main building the first of the six main turbo-alternators is installed and the second is awaiting its low pressure rotor. Three main condensers and one dump condenser are installed. In the auxiliary turbine house where there will be three sets the first condenser is in position and is being tubed up below No. 1 turbine block. Equipment of the station control room is proceeding and the standby diesel house, battery room and water treatment plant are ready. The circulating water system, including pump house and offshore barrier wall with inlet and outlet cofferdams is nearly completed as is the carbon dioxide storage plant at the north east corner of No. 1 reactor building.



LETTERS AND LITERATURE

Letter to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SOCIALISM OUT OF DATE ?

SIR,—As a Labour candidate in the recent election, I was interested to read the first leading article in your issue of October 16. You rightly note that the Labour Party's proposals were more specific than those of the Conservatives and go on to explain why, in your opinion, they were rejected by that part of the electorate which is not set in its ways. Specific or not, some of these proposals seem to have been misunderstood by your leader writer. When you write " people who are comfortably off like to own their own houses and have no desire to see them municipalised " you are doubtless correct, but irrelevant. There was no proposal to municipalise people's " own " houses and no need, therefore, for the owner-occupier to be alarmed. The man who had cause for alarm was the man who owns other people's houses—the private landlord. You also suggest that the re-nationalisation of rail transport smacks of pique and hope that that proposal is now dead. Dead indeed it is, for it was never raised. An industry already nationalised is in no need of re-nationalisation.

Later you remark that " as a means of controlling an industry for the benefit of the community, nationalisation has, in fact, not proved very effective." Surely the late Conservative Government's use of the investment programmes of nationalised industries as a means of controlling inflation was for the benefit of the community and was much more precise than the cumbersome use of a high bank rate and the credit squeeze. If anything, the Chancellor could have done with more nationalised industries for that purpose rather than less.

Although there is much sense in your article, I have been obliged to dwell on its faults for they seem to show only a partial comprehension of Labour's policies. Perhaps our fresh thinking should be directed toward educating the electorate.

W. HOWIE

London, N.W.11,
October 23, 1959.

[We should point out that we referred to re-nationalisation of road and rail transport. We would have made our meaning clearer, perhaps, if we had used hyphens, thus road-and-rail.—ED., THE E.]

Book Reviews

Process Dynamics. By DONALD P. CAMPBELL. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 84s.

FOR many years Dr. Donald P. Campbell carried out research in the theory of servo-mechanisms as applied to dynamical systems. His valuable contributions in this field have been followed by this book on the theoretical analysis of processes. He had not quite completed the book before his untimely death in January, 1957, and the final preparation of the book was undertaken by Dr. Page S. Buckley.

The main theme of the book is to express dynamical processes (continuous or discrete) in terms of differential or difference equations and then consider the behaviour in response to given disturbances, where possible using Laplace transform methods. The difficulties encountered in dealing with continuous systems and non-linearities in many processes are outlined but not thoroughly investigated. Recourse is often made to a statement to the effect that a solution, if it is possible at all, must be obtained by numerical methods. Nevertheless, the methods of formulation are themselves valuable and it is not uncommon in practice for a neat solution, in terms of known functions available in a dictionary of transforms, to be impossible. The realism of the book in this respect is not necessarily a criticism, but it would be interesting to have seen more practical cases brought to a conclusion.

The first chapter, on kinematics of material handling, deals with storage, the regulation of flow, transportation lag, mixing and blending. It is followed by a chapter on fluids in motion concerning liquid levels and their regulation, control of flow of uncompressible and compressible fluids, pressure regulation and dampers. The third chapter is called Forming, Propulsion and Guidance, and treats extrusion and casting, variable speed drive, tension control. Chapter four, on thermal process dynamics, covers convection heaters and convective heat transfer, liquid and vapour heat exchangers and the dynamic response of heat exchangers. In Chapter five mass transfer dynamics includes diffusion and distillation leading to chemical process dynamics in Chapter six which outlines reaction kinetics, manipulation of chemical reaction systems and recycling processes. There follows a set of problems on each chapter some of which, it is claimed, may not have solutions.

The book is of interest to engineers who are not already experts in servo-mechanisms theory and who are looking for guidance in applying feedback theory to process control problems. It assumes a knowledge of the solutions of ordinary and partial differential equations using Laplace transformation methods. To the expert in servo-mechanism theory applied to electro-mechanical systems, this book of Dr. Campbell's efforts to explain the dynamics of various processes will be a stimulating example to follow.

Radio Stations : Installation, Design and Practice. By G. A. CHAPPEL. Pergamon Press, Ltd., 4 and 5, Fitzroy Square, London, W.1. Price 50s.

THIS book is concerned with every aspect of radio transmitters and receivers except the details and principles of their circuits. The contents can be judged from the following list of chapter titles : " Building Sites," " Buildings," " Masts and Towers," " Transmission Lines," " Aerial Systems," " Transmission-line Switching Systems," " Electrical Wiring," " Control Units," " Equipment Racks," " Message-distribution Systems and Workshops." Appendices are devoted to " Fault-finding Procedure " ; " Maintenance Methods," " Procedures and Organisation " ; " A Selection of Control Systems." It is claimed on the jacket of the book that this is the first complete work on the installation and design of radio stations. This is not true, but it is certainly one of the few books that exist on the subject. The author deserves congratulations on tackling a book on such a wide diversity of subjects. But it is, of course, too much to expect a single author to be an expert on all these subjects, and there are a number of errors. Unfortunately, too, long words are very often preferred to short ones and complex syntax to simple. We sometimes found it difficult to extract any meaning at all. Doubtless there is much good material in the book : it is a pity so much trouble is required to extricate it.

Contribution à l'Analyse de la Turbulence associée à des vitesses moyennes. By A. CRAYA. Publications Scientifiques et Techniques du Ministère de l'Air, No. 345. Paris: Magasin C.T.O.: 2, Avenue de la Porte-d'Issy, Paris (15e). Price Fr.1480.

THE present research report deals with the anisotropic turbulence normally met with, e.g. in ducts, and seeks to analyse its structure. To this end the case is considered where average velocities are linearly distributed in space and the associated turbulence is homogeneous but anisotropic. The mean flow has a distorting influence on the downstream velocity fluctuations, the mechanism being given by the correlation equations between two and three points and their Fourier transforms. as shown in Chapter 1, while the following section demonstrates that an important simplification can be made if the fluid is considered incompressible. The original equations are transformed into reduced equations ; a particularly important case is discussed, in which the flow reduces to a single distortion. The final chapter reverts to the starting point of the investigation, the study of the mean velocities and pressures, and those of the derivatives of the velocity.

Books Received

Interavia ABC, World Directory of Aviation and Astronautics, 1959. Interavia, Geneva 11, Switzerland. Price 80s.

The British Engineers' Handbook, 1959. The British Engineers' Association, 32, Victoria Street, London, S.W.1. Price 21s.

The Structure of Metals : A Modern Conception. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 25s.

Reading German for Scientists. By H. Eichner and H. Hein. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 30s.

Singularitätentheorie der Flügelgitter. By L. Meyer. Verlag Leemann A.G., Arbenzstrasse 20, Postfach, Zürich 34, Switzerland. Price Sw.Fr.28.

Enjoy Work and Get Fun Out of Life. By A. O. Battista. Elliot Right Way Books, Kingswood Building, Kingswood, Surrey. Price 7s. 6d.

Introduction to the Theory of Compressible Flow. By Shih-i-Pai. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price 73s.

Descriptive Geometry. Second edition. By E. G. Pare, R. O. Loving and I. L. Hill. The Macmillan Company, New York, 10, South Audley Street, London, W.1. Price 35s.

SHORTER REPORTS

Proposed Site for Thermonuclear Research Establishment

THE United Kingdom Atomic Energy Authority intends to apply for planning permission to acquire a site of about 175 acres inside the perimeter of the Royal Naval Airfield at Culham, Oxfordshire, and to develop this site as a new research establishment. It would be used for research into controlled thermonuclear reactions and plasma physics and the study of nuclear fusion as a possible source of industrial power. Most of the thermonuclear research now carried on at Harwell and Aldermaston would be moved to the new establishment. It may be recalled that just over a year ago the Authority decided that the controlled thermonuclear project should be moved from the Atomic Energy Research Establishment at Harwell because Harwell was becoming too large for convenient management. It was originally thought that a suitable location would be the new research establishment then being developed at Winfrith Heath in Dorset. On reconsideration it was decided that, because the project would, for some years, be concerned with basic studies, preference should be given to a site nearer the Atomic Energy Research Establishment and the National Institute for Nuclear Research (both at Harwell) and to Oxford University. Culham was found to be the best site of adequate size and with the necessary good communications to meet this requirement.

One of the first tasks at the new site, if approved, would be the construction of "I.C.S.E." (Intermediate Current Stability Experiments), a large machine which, as announced at the Authority's annual press conference in July, will incorporate the results of experience with "Zeta" and of other studies in this field, both at home and abroad.

It is planned that the total numbers employed at the proposed new establishment will rise to 1000 and that this figure will be reached within four or five years.

Radar and Navigational Aids

THE inaugural meeting of the Radar and Navigational Aids Group, British Institution of Radio Engineers, was held in London on October 28, under the chairmanship of Professor E. E. Zepler, president of the Institution. Three short addresses were given, two of them dealing with the history of radio and radar navigation at sea and in the air, and the third with future trends in these applications.

Captain J. D. Elvish, group marine superintendent and a director of the British and Commonwealth Shipping Company, Ltd., spoke on "Radio—Its Impact on Shipping." His talk mentioned early experiments and the subsequent commercial equipment of ocean-going vessels, and proceeded to review the evolution of navigational aids as distinct from radio communication facilities. The influence of two wars was discussed, and finally a résumé was given of legislation directly caused by the advent of radio at sea.

Air Marshal Sir Raymond G. Hart, Director of the Radio Industry Council, and Controller of Engineering and Equipment at the Air Ministry from 1956–59, presented "A Historical Survey of Radio and Radar Aids to Aircraft Navigation." He traced the parallel evolution of radio and aeronautics in the same generation in relation to applications of radio to air navigation, with special reference to radio techniques adopted for increasing the effectiveness of aircraft as weapons of war.

Mr. Caradoc Williams reviewed "Future Trends in Radio and Radar Navigation." He commented on existing techniques and suggested the need for devoting more technological effort to the subject of collision warning and prevention, both for ships and aircraft. In future inertial systems of navigation were likely to be used in conjunction with radio position fixing to provide accurate indication of aircraft movement between radio fixes. The science of radio astronomy might provide techniques complementary to astro-navigation, and there were already indications that earth satellites might be used for radio navigational purposes. For berthing ships, closed circuit television transmission of the harbour radar display and other information might be useful.

In areas of high air traffic density the introduction of electronic air movement stores and computers was likely to become a necessity in the next few years. It was envisaged that a flight plan would be accepted or rejected by examining it in the computer store for compatability with other aircraft movements. To some extent digital communications were likely to take the place of radio telephony communication with aircraft because many aircraft could be served simultaneously with discrete information at a high information rate by time division multiplex on a single frequency channel. Digital data were very suitable for aircraft position fixing and altitude reporting, being in a form appropriate to electronic computers.

Improvements at King George Dock, Hull

THE British Transport Commission has authorised a £4,750,000 scheme of improvements at King George Dock, Hull; it includes the extension of three quays, the provision of additional transit sheds, cranes, grain elevators and silo accommodation.

The main expenditure, amounting to over £2,000,000, will be on the north side where No. 1 quay will be extended from 1270ft to 3700ft by converting the present echelon formation into a straight wharf and removing the redundant coal loading plant. This will provide, along the entire length of the north side, simultaneous berthing accommodation for six of the largest ships using the dock. Four additional single-storey transit sheds are also to be built with a total floor area of 260,000 square feet, and ten additional electric cranes, each of 6 tons capacity.

Other principal improvements are at quays 12, 11, 7 and 3. They include two single-storey transit sheds with a total floor area of 150,000 square feet, and improved rail and road facilities at No. 12 quay, thus completing the modernisation of the quay, which was formerly timber built and has recently been reconstructed in concrete. At No. 11 quay replacement of the existing timber-built quay, used for repair of vessels afloat, by a reinforced concrete structure is envisaged with extension from 275ft to 600ft; and provision of a 10-ton electric portal crane.

Quay No. 7 is to be extended from 450ft to 600ft, four 10-ton electric cranes for discharging bulk dry cargoes by grab are to be installed, and extensive railway facilities laid. Two pneumatic grain elevators in addition to four already installed on North Quay, will be provided at quay No. 3, and there will also be one extra floating elevator with a capacity of 200 tons per hour, as well as extension of silo accommodation from 40,000 tons to 60,000 tons.

The whole scheme includes a sum of £150,000 for a modern fleet of mobile cranes, fork-lift trucks and other mechanical aids to ensure efficient movement of goods in the transit sheds.

King George Dock, which was built jointly by the former North Eastern and Hull and Barnsley Railway Companies and opened in 1914, is the largest of the eleven docks in the Port of Hull owned and managed by the British Transport Commission. It is capable of admitting on all tides vessels drawing up to about 27ft, but some ocean cargo ships do not have free access because of their greater draught. The Commission is, therefore, undertaking a hydrographic survey of the conditions around the dock entrance with a view to introducing measures that would enable larger vessels to enter or leave on all tides. This may be accomplished by installing impounding pumps to transfer water from the river into the dock and so raise the minimum level on the inner sill by approximately 4ft.

Mendlesham Television Station

THE Mendlesham transmitting station of the Independent Television Authority began the transmission of programmes provided by Anglia Television, Norwich, on October 27. The programme transmitters have been supplied by the Television Department of Pye, Ltd., Cambridge, and an engineers' supervisory link, comprising one fixed and three mobile microwave stations by Pye Telecommunications, Ltd., Cambridge. The contractor for programme microwave link equipment in connection with the station was Marconi's Wireless Telegraph Company, Ltd., Chelmsford, Essex. This consists of a duplicated unidirectional link from London with three repeater stations and uses the company's "HM200" travelling wave tube equipments.

An unsymmetrical radiation pattern was necessary in order to provide strong signals in the directions of Norwich, Peterborough, Cambridge and Colchester, but to meet international planning requirements by reducing radiation drastically towards London, the South Coast and the Amiens areas. For this purpose a new form of aerial system, known as the "Mesney" was designed by E.M.I. Electronics, Ltd., Hayes, Middlesex, which has the additional characteristic that because fewer feed points are necessary than normal, the de-icing problem is simplified and overall complexity reduced. The 1000ft mast—the tallest in the Commonwealth—is triangular in section with sides 6ft 6in wide at the aerial section. The aerial system consists of two bays, each 50ft long, and provides exceptionally high gain, enabling a comparatively low input of 8kW from the transmitters to give an effective radiated power of 200kW in the desired directions.

British Insulated Callender's Construction Company, Ltd., 30, Leicester Square, London, W.C.2, was responsible for the design and erection of the aerial supporting mast, and the steelwork was fabricated by Painter Brothers, Ltd., Hereford. Mendlesham is the ninth transmitting station to be built by the Independent Television Authority, and raises the proportion of the population of the United Kingdom within one or other of the I.T.A. service areas to 90 per cent.

Bearing Pads for Bridges and other Structures

A BEARING pad made of natural rubber, reinforced with steel, has been introduced by P.S.C. Equipment, Ltd., Arundel Road, The Industrial Estate, Uxbridge, Middlesex. The rubber is bonded between two thin sheets of steel, to form a sandwich, the greater thicknesses being obtained by building up these sandwiches. All movement, including shear and rotation of the bearing is taken up by the rubber itself. The pads are made in any size, but the size and shape necessary for an individual structure may be calculated from data supplied on a simple form. "Freyssi" pads as they are called, are claimed to last for many years, probably for the life of the structure, but if they have to be replaced the operation is simple, the makers assert. Furthermore, it is considered that the cost of pads for spans up to about 120ft is less than that of steel bearings, but it may be rather more for longer spans.

[Reply Card No. E.5265]

Site of the high-pressure gasification plant at Westfield in Fife. This plant is expected to be producing 15,000,000 cubic feet of gas a day from low grade coal by early 1961. A second stage, due for completion by September, 1962, will double production

High-Pressure Gasification Plant in Scotland

In our issue of March 7, 1958, brief mention was made of the order placed by the Scottish Gas Board for the installation of a Lurgi plant for making gas from low-grade coal at a new works at Westfield in Fife. The work of clearing the 48-acre site and laying foundations for the plant was started in the summer of 1958 and, at the invitation of the Scottish Gas Board, we recently visited Westfield to see the progress of work to date. Some particulars of this interesting scheme, the first of its kind in this country, are worth recording before we deal with the work which has been completed.

For the new gas works it is proposed to take low-grade coal by a belt conveyor system directly from the washery of a nearby opencast working. This coal, containing up to 25 per cent ash and 16 per cent moisture, is to be completely gasified, leaving only ash to be disposed of in worked-out parts of the coal winning site. Initially, the plant, which will cost some £6,600,000, will have an output of 15,000,000 cubic feet of gas a day and take about 266,000 tons of coal a year. In a second stage of development coal consumption will increase to 400,000 tons a year, and in a third stage to 600,000 tons a year when the gas output will be 30,000,000 cubic feet a day. The workings have a potential output of 600,000 tons of coal a year, and at this rate their productive life will be twenty to twenty-five years. When no further coal is available from the opencast workings, low-grade small coal will be taken from other mines in Scotland.

It is expected that gas making will begin towards the end of next year. The works are being connected by a high and medium pressure grid mains system over an area extending from the counties of Perth and Angus in the north-east and through the counties of Kinross, Fife and Stirlingshire to Lanarkshire in the south-west, and to the Lothians. With this grid, which will have an overall length of 133 miles, the total cost of the scheme will be nearly £8,500,000.

Unwashed opencast coal will be delivered on the belt conveyor to a crushing and screening house, where the $\frac{1}{4}$in to $1\frac{1}{4}$in will be taken for gasification to the storage bins of the Lurgi plant. The smaller coal will be diverted to a boiler plant used to provide the large quantities of steam required in the Lurgi process, in which gas is made by the reaction with coal of steam and oxygen under high pressure. To supply the necessary oxygen a tonnage plant is being installed on the site. The gas produced in the Lurgi gasifiers will have a heating value of just over 400 B.Th.U. per cubic foot and in the first stage will be enriched to 450 B.Th.U. by the addition of butane, to be obtained from the Grangemouth refinery.

The gasifiers are being provided under an agreement made between Humphreys and Glasgow, Ltd., the main contractor for the plant, in association with the Power Gas Corporation, Ltd., and the firm of Lurgi of Frankfurt. The three gasifiers to be installed in the first part of the scheme are being supplied from Germany and those supplied under the subsequent developments will be made in this country. Each of these welded pressure vessels is 9ft 10in diameter, 28ft long and weighs some 50 tons. They are designed for a working pressure of about 25 atmospheres, and when in full production each will require 240 tons of coal, 60 tons of oxygen and 220 tons of steam daily to produce some 7,500,000 cubic feet of gas a day.

The "Tonnix" oxygen plant being supplied by British Oxygen Linde, Ltd., incorporates means of drawing off and storing oxygen in liquid form. The storage capacity for 550 tons of oxygen will enable full gas production to be maintained for an appreciable time when the oxygen plant has to be stopped for maintenance work. For steam supply purposes, Babcock and Wilcox, Ltd., is installing two "Igna-fluid" stoker-fired boilers designed to run on the low-grade fuel available.

Tower purifiers of the Bischoff design, being supplied by Newton Chambers and Co., Ltd., for high-pressure operation, will have a capacity for 30,000,000 cubic feet of gas a day. These purifiers will remove traces of hydrogen sulphide remaining in the gas after it has been cooled and passed through a Benfield washing plant, the primary purpose of which is to remove carbon dioxide. After purification there will remain sufficient pressure in the gas production stream to distribute the gas through the grid system.

The pipeline which will carry the gas to local grid systems round Glasgow, Perth and Dundee is designed for a maximum working pressure of 300 lb per square inch, and it will include some 75 miles of 12in diameter line with 58 miles of branch line ranging from 8in to 3in diameter. The pipes of seamless drawn steel are being supplied in lengths of 25ft to 45ft and they are being laid by a number of squads of men using similar mechanical equipment and methods to those in oilfield pipeline construction. Each squad, under favourable conditions, can lay a $1\frac{1}{2}$ miles long section in a week. As each section is completed, it is first subjected to an air pressure test and then under hydraulic pressure at 450 lb per square inch.

The general appearance of the Westfield gas works site a week or so ago is shown by the photograph we reproduce on this page. The four towers of the Benfield plant have been erected and are now being filled with their rings before the piping and installation work is put in hand. The steelwork for the oxygen plant building has been completed and much of the brickwork laid. The steel framework of the Lurgi gasifier house has been completed and the first two gasifiers slung into position. Work is now proceeding on the coal bunkers above the gasifiers and all is ready for the installation of the third gasifier to be installed under the first part of the scheme. Our photograph was taken before the gasifiers were installed but the framework of the building can be seen in front of the large Benfield tower on the right of the group. On the left in front of the towers are the two benzole absorber towers. A lock gas holder is under construction (on the right of the photograph) and in front of it are the foundations for an effluent tank.

The foundation work has been practically completed for all the other plant, including the boiler house, a substation and waste gas disposal plant.

Printed Circuit Connections

We are informed by Simmonds Aerocessories, Ltd., Treforest, Pontypridd, Glamorgan, a member of the Firth Cleveland Group of Companies, that several developments have taken place in the application of "Spire Speed" fastenings to printed circuit connections. The "Spire Speed" nut (S.N.O. 2567) has been adapted for connecting main leads to circuits of this kind by forming it with a flange which clips over the edge of the panel and upturned sounds which hold a spade terminal steady against vibration and prevent it from turning when the screw is tightened into the fixing hole.

The stand-off tag (S.C.O. 2755) in its printed circuit form provides a means of connecting flying leads to the printed wiring. It can be fitted into a $\frac{3}{32}$in diameter hole, in which it is maintained vertical by a pair of spring steel legs biting into the sides, and can then be soldered to the printed circuit at the same time as the other components.

Various individual problems have also been overcome by the use of the series of fastenings, such as the attachment of plastic extensions to line control shafts, mounting screening cans on printed circuit panels, and insulated fixings for sheet metal using nuts with a floating nylon insert which receives a self-tapping screw. A special trimmer was developed in co-operation with one manufacturer for installation in a limited space. The difficulty was overcome by using a disc of $\frac{1}{16}$in diameter copper to form one plate, which was connected to the grid side of the circuit; the "earthy" plate of the trimmer consisted of the head of the adjusting screw, and this was connected into the circuit by an S.N.O. 2470 fastening. A mica washer 0·001in thick formed the dielectric.

[Reply Card No. E5272]

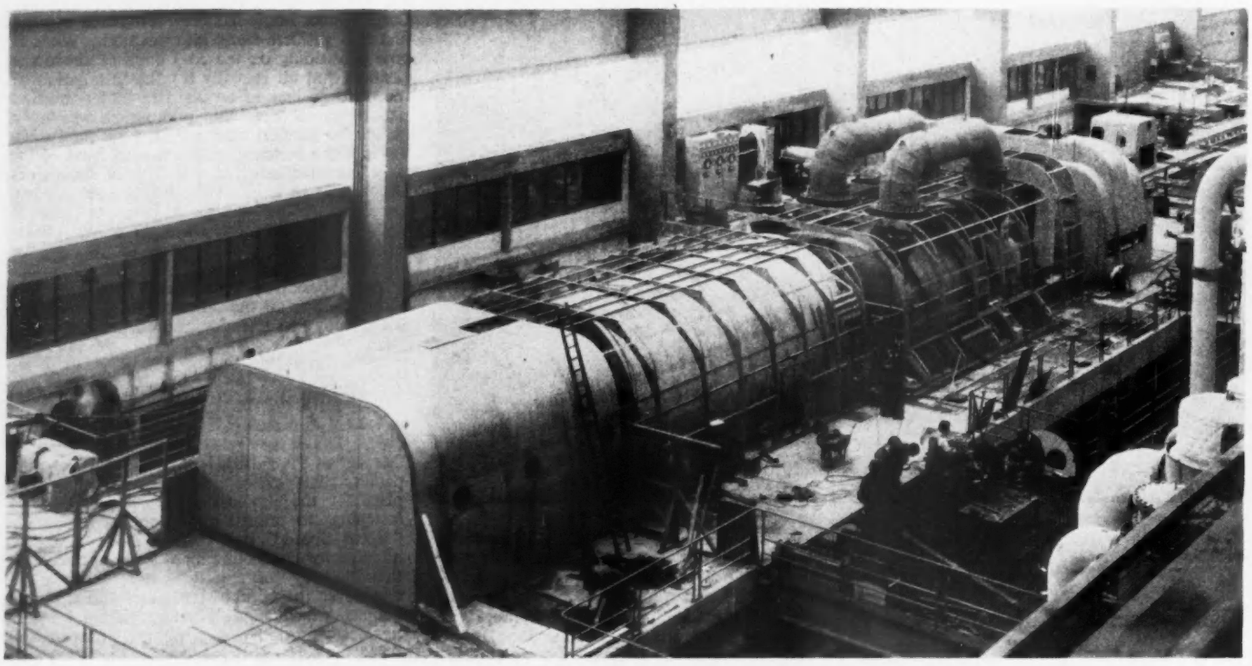
Precision Clinometer

A Microptic precision clinometer which reads direct to 1 second of arc, with estimation to 0·5 second, over an an angular range of 0–360 deg., has been introduced by Hilger and Watts, Ltd., 98, St. Pancras Way, London, N.W.1. With it inclinations are measured by reference to a horizontal plane, indicated by an incorporated spirit-level and repetition of bubble settings to 1 second of arc is made possible by an optical coincidence-reading system and a slow-motion setting control.

The circular glass scale is totally enclosed and the micrometer microscope eliminates any eccentricity effects in the circle by automatically averaging sub-divisions made on two sides of the circle. The microscope eyepiece is inclined at an angle of 45 deg. and is rotatable.

The steel base of the instrument has two lapped sides square to each other for reference purposes and three lapped supports on the back of the clinometer enable it to be used in the horizontal position. Accessories available include a worktable for measuring angular displacements of small parts, and an adjustable reflector which, in conjunction with an auto-collimator, can be used for setting out angles. Both of these accessories are interchangeable with the spirit-level unit. The microscope-reading system and the spirit-level are illuminated by separate low-voltage lamps.

[Reply Card No. E5273]



The first of five 200MW turbo-generators at High Marnham power station

First 200MW Set at High Marnham

THE first 200MW steam turbo-generator unit in Great Britain went into service at the High Marnham power station of the Central Electricity Generating Board on October 15. The turbo-generator was built by The English Electric Company, Ltd., and the associated boilers by International Combustion, Ltd. This 200MW unit is the first of five to be installed at High Marnham, near Retford, Notts.

The turbine was described in an article on "Large High-Pressure High Temperature Steam Turbines" by John Caldwell in our issue dated June 15, 1956, Vol. 201, page 662.

It will be recalled that the turbine is a horizontal three-cylinder 3000 r.p.m. machine having a double-casing high-pressure cylinder with impulse blading. Steam (2350 lb per square inch gauge and 1050 deg. Fah. at the turbine stop valve) enters the nozzle chamber in the h.p. cylinder through two pipes in the middle of its length and flows through eight stages of impulse blading (contained by the inner casing) away from the driving end of the set. On leaving this impulse blading, at 837 lb per square inch absolute and 793 deg. Fah., the steam flows between the inner and outer casings and returns to the middle of the h.p. cylinder and then traverses four more stages of impulse blading towards the alternator end of the cylinder. After this expansion the steam is at 490 lb per square inch absolute and 667 deg. Fah., and is taken to the reheater whence it passes to the i.p. cylinder at 430 lb per square inch absolute and 1000 deg. Fah. The i.p. cylinder has an inner casing to house three of the eight rows of impulse blading. The i.p. rotor and one section of the three-flow l.p. expansion are combined on one shaft. Between these two groups of blading (i.p. and l.p.) steam is taken by overhead connecting pipes to the double-flow l.p. cylinder. Bled steam for the lower stages of feed heating is taken from the twin-flow l.p. expansions only, no steam being bled from the l.p. expansion in the i.p./l.p. cylinder. All three l.p. expansions exhaust into a common exhaust chamber and a single shell condenser at a vacuum of 28·7in Hg at the most economical and continuous maximum rating of the set when using cooling water at 60 deg. Fah.

The condensing plant, which was made at the Netherton works of The English Electric Company, Ltd., includes a 115,000 square feet single-shell condenser, two full-duty extraction pumps, three 50 per cent duty rotary Leblanc type main air pumps and two quick-starting exhausters.

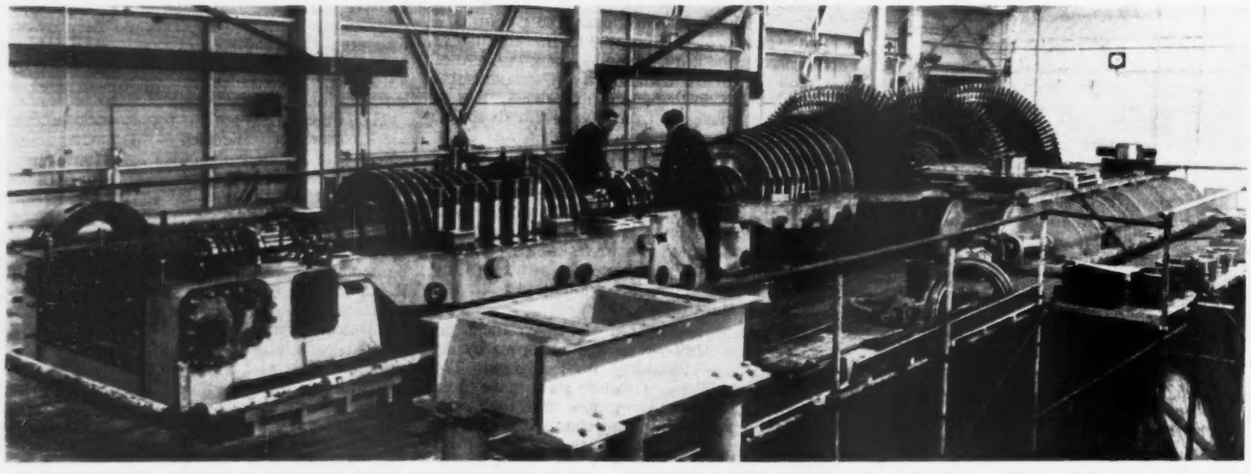
There is a six-stage feed water system giving a maximum temperature of 460 deg. Fah. at continuous maximum rating. Feed water de-aeration is supplied with provision for off-load de-aeration.

The secondary governor, which includes in its layout magnetic amplifiers, has been designed to reduce overspeed after load rejection by faster closure of the throttle valves.

In the alternator hydrogen is used for direct cooling of the stator and rotor conductors at a rated gas pressure of 30 lb per square inch gauge. Generation is at 16·5kV, the design power factor being 0·9, short circuit ratio 0·75, and rated phase current 7780A.

The hydrogen gas is circulated through the hollow conductors by means of an axial, multi-stage blower mounted in the upper part of the stator frame and driven via a cardan shaft and flexible couplings from the exciter gearbox. The hydrogen coolers are arranged longitudinally in the upper part of the stator frame and are so divided on the gas side that the gas is cooled before entering the blower and again after leaving it.

The exciter, which is driven through reduction gearing from the main shaft at 750 r.p.m., has a maximum rating of 3000A at 520V. Coupled to it is a control exciter operating in conjunction with the "MAEX" continuously-acting magnetic-amplifier automatic voltage regulators.



Turbine rotors of 200MW set in position on bottom half casing

Control of Sulphur in Liquid Fuel Firing

WE are informed by Combustion Chemicals Ltd., 33, Dorset Square, London, N.W.1, that it has completed a full-scale trial on an operational boiler burning heavy residual fuel oil, to determine the reduction in sulphur dioxide and sulphur trioxide in flue gases. The trial was conducted by the National Test Laboratory in Paris and it is concluded from the results that "Desulfurol" sulphur inhibitor and fuel oil improver, when added to residual fuel oils at one part per 1000, not only largely inhibits the formation of sulphur oxides, but also improves certain qualities of the fuel oil. CO_2 levels and steam output are increased and flame temperatures are higher. It is claimed that the control of sulphur exercised by the addition of "Desulfurol" to fuel oil in the storage tanks leads to a reduction in the build-up of sulphate scale and acidic soot deposits and also in sulphur fumes and sulphur contamination. Below are extracts of the full report which states that for the trial a Babcock and Wilcox boiler having a total heating surface area of 323 square feet was used, and No. 2 Heavy Residual fuel oil, having a viscosity of 2200 seconds Redwood No. 1 and sulphur content of 3·88 per cent. The test, using internationally accepted procedures, was to determine the effect of "Desulfurol" treatment on: the CO_2 percentage in the flue gases; the SO_2 and SO_3 levels in the flue gases; and the flame temperature:

	Untreated fuel oil	Treated fuel oil
Preheat temperature, deg. Fah.	198	167
Ambient temperature, deg. Fah ...	92	85
Air heater outlet temperature, deg. Fah.	510	455
Steam output, pound per hour	1934	2067
CO_2 percentage	10·8	12·8
CO percentage	0·15	0·10
O_2 percentage	5	4
SO_2 average of three tests	4·38	3·12
SO_3 average of three tests	0·049	0·018
(expressed as grammes per cubic metre of gas at 0 deg. Cent.)		
Flame temperature:		
30cm from burner tip, deg. Fah. ...	2444	2506
60 cm from burner tip, deg. Fah. ...	2245	2390
100cm from burner tip, deg. Fah. ...	2120	2192

[Reply Card No. E5291]

Self-Locking Clamping Drill Jigs

A DESIGN of lever-operated clamping jig now made by F. Pratt and Co., Ltd., Halifax, under licence from N. A. Woodworth Company, of the United States, is available in five models. With interchangeable parts, eighteen sizes are covered to provide for workpieces with areas from

Lever operated self-locking "Cone-Lok" jig

1in square to 12in by 9in. The general design and operating principle of these jigs can be seen in the photograph we reproduce.

Each jig consists essentially of a heavy cast base, incorporating a table, and a head guided on vertical columns. The head is raised and lowered to unclamp and clamp components on the table through a shaft actuated by a helical rack and pinion. As the handle on the pinion spindle is swung over to draw the head down on to the component, cones at each end of the spindle impart a proportional locking effect as the clamping load of the head on the component increases. This clamping and locking action is imparted at any point during the downward movement of the head so that irregularities in component height are automatically compensated.

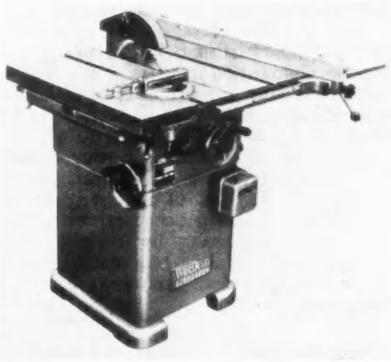
Heads are made in a number of different forms for these "Cone-Lok" jigs, and they can be either directly drilled and bushed or fitted with interchangeable dowelled bush plates. The smaller capacity jigs have overhung heads such as that shown in the illustration, whilst heavy duty jigs have bridge design heads.

[Reply Card No. E5292]

Sliding Table Saw Bench

A RECENT addition to the woodworking machinery made by Wadkin, Ltd., Leicester, is a 10in sliding table dimension saw bench designed to work to precision limits at high production rates. This machine with its tilting saw and range of fences and cutting-off gauges is designed for cutting straight, angular or compound angles and straight or bevel ripping work.

The machine has a cast body mounted on a welded steel sub-base and its table is made in two sections. A fixed table on the right of the saw is 20in wide by 28in deep, and the sliding table on its left is 14in wide by 28in deep. This left-hand table runs on two steel rods and four



10in sliding table dimension saw bench

ball-bearing mounted grooved rollers incorporating adjustment means to take up wear. A ripping fence which runs across the full width of the table moves on two ground guide bars and can be clamped in position by a single cam-lock lever. The graduated front bar of the fence has means of fine screw adjustment for precision setting.

The saw spindle is mounted on sealed ball-bearings and its rise and fall movements and canting settings are effected through worm and gear quadrant by handwheels fitted with locks. A graduated scale shows the angle of saw cant and with the saw at right angles the maximum depth of cut is 3in. If required dado or grooving sets up to 6in by $\frac{3}{16}$in or circular moulding cutter-blocks up to 4$\frac{7}{16}$in diameter by $\frac{3}{4}$in can be fitted on the machine. There is also available an extension sliding table with outer floor supports which gives a cut-off length of 80in using a turnover stop with the stop bar in extreme position. A fixed extension table can also be fitted to the right of the saw which increases the distance between the saw and ripping fence to 48in.

The equipment supplied with the saw bench includes a double mitre fence using either back or front, a straight cross-cutting fence, and two interchangeable stop bars with turnover stops for use with these fences. A swivelling mitre fence, which can be used on either side of the saw, will give any cutting angle for angular or compound angular sawing.

[Reply Card No. E5293]

Variable Transformer

AN addition to the Philips range of variable transformers, which in the 240/250V range previously had a maximum secondary rating of 8A, is the "E401/200," which on a 240V, 50 c/s supply provides an output voltage continuously variable from zero to 270V at a nominal current of 20A. We are informed by Research and Control Instruments, Ltd., Instrument House, 207, King's Cross Road, London, W.C.1—sole distributor for these transformers in the United Kingdom—that an important reduction in size

Continuously-variable, strip-wound auto-transformer with grain-oriented core

for a variable transformer of this rating has been achieved by a grain-oriented core with strip-wound auto-transformer winding. With the bench-mounting model illustrated, the overall diameter of the circular case is 12$\frac{1}{2}$in, while in the skeleton version for panel mounting this dimension is further reduced, and connections are made to terminals on the underside of the unit instead of to the projecting terminal box seen in the illustration. Adaptor plates are available for alternative fixing centres. The height of the transformer as illustrated is 6in to the underside of the adjusting knob. Transformers can also be supplied in a motor-driven form.

A counterbalanced brush arm provides a low-torque movement over the 320 deg. scale and, in addition to making for smooth operation, facilitates control of the transformers when coupled for series, parallel or three-phase use. For this purpose the transformers are stacked vertically, and coupling is facilitated in the present design by a more easily reversible spindle.

The contact arrangement is of multi-brush, self-aligning form and operates on a track coated with silver alloy to minimise oxidation.

[Reply Card No. E5294]

High-Speed Digital Computer

FOLLOWING the recent announcement by the National Research Development Corporation that it is supporting the development of "Atlas," a large-capacity high-speed fully transistorised digital computer, Ferranti, Ltd., Hollinwood, Lancs, stated recently that "Atlas" would be of the order of a hundred times faster than "Mercury," at present the fastest electronic computer in Europe. Computer engineers of Manchester University and Ferranti, Ltd., are now engaged in constructing the first machine, which will be installed at Manchester University. It will be working about the turn of the year 1961–62 and will be the prototype for the Ferranti "Atlas" production models, which will cost about £1,000,000 each.

It is stated that the simple operation of adding a number into the accumulator register, an integral part of many instructions, will be completed by the computer in 0·2 microsecond, and more complicated functions of the computer will be correspondingly faster than in current machines. A special feature of "Atlas" will be its ability to switch to another programme if the main programme is held up for any reason. The computer will therefore be continuously available to deal with jobs which originate with little or no advance notice.

[Reply Card No. E5295]

Industrial and Labour Notes

Hours of Work

Proposals for the shortening of the working week have been freely discussed by the trade unions during the past year and claims for a reduction in hours have been submitted in some industries, including the engineering and shipbuilding industries. Some useful comment on the subject is made in the October issue of *Bulletin for Industry*, which is prepared by the Treasury. There, it is pointed out that in most industries the basic working week is at present forty-four or forty-five hours. Figures collected by the Ministry of Labour show that, in the last week of April, the average hours worked in industry in this country were 46·3, with men working forty-eight hours and women 41·5 hours. Hours in the manufacturing industries were rather shorter than elsewhere and there was considerable variation between industries.

The *Bulletin* says also that returns from manufacturing firms employing ten or more people show that at the end of August rather more than 25 per cent of the 5,250,000 operatives covered by the inquiry were working overtime, the average being 7½ hours a week. The number of operatives concerned was greater than in 1958 but a little less than in 1957. The average week worked by men (twenty-one and over) reached a post-war peak of 48·9 hours in 1955—implying overtime on average of four to five hours a week—after a steady rise from 46·3 hours in 1947, with only a slight pause in 1952–53. From 1955 to 1958 the average week worked fell at the rate of about half an hour a year, which brought it to 47·7 hours in October, 1958. There was a rise to forty-eight hours in April, 1959, the same figure as a year earlier.

It is added that the hours worked in United Kingdom industry are very similar to those in other West European countries, though more than in North America. The average per week for all workers in this country's manufacturing industries last April was 45·7 hours. In Germany, the average was forty-six hours, in France 44·3 hours and in Switzerland 46·6 hours. In Canada and the U.S.A. the averages were 40·3 and 40·7 hours respectively.

Overseas Trade

The Board of Trade has now completed its survey of trends in the United Kingdom's overseas trade in the first nine months of this year. It shows that exports during that period were 3 per cent higher in value than in the comparable period of 1958 and, as there was little change in average prices, the increase in volume was about the same. Since the country's export trade began to improve in April, the average increase, compared with last year, has been of the order of 8 per cent. Imports in the first nine months of this year were 5 per cent higher in value and about 7 per cent greater in volume than in the corresponding period of 1958. Towards the end of the third quarter, average import prices were rising again. Re-exports in the first nine months were rather less than in the comparable period of last year, mainly, the Board of Trade says, because of the cessation of shipments of rubber to the Soviet Union for most of the period. The visible trade deficit averaged £43,000,000 a month between January and September, compared with £34,000,000 a month in the corresponding period of 1958.

Dealing with the commodity pattern of trade, the Board of Trade estimates that United Kingdom exports rose by 3 per cent during the first three quarters of this year compared with the corresponding period of 1958, this year's improvement beginning in the second quarter. Of the total increase, amounting to £69,000,000, engineering products accounted for £46,000,000 and chemicals for £19,000,000. There was also a large increase in exports of iron and steel scrap of about £10,000,000, but exports of fuels declined by £11,000,000. The increase in engineering exports occurred in spite of falls of £5,500,000 in railway vehicles, £5,500,000 in ships, and £4,500,000 in aircraft and parts other than engines. But exports of machinery other than electric increased in value by £32,000,000 in the first nine months of this year. That figure included an £11,000,000 increase in aero engine exports to a level 30 per cent above that in the corresponding period last year. Apart from aero engines, there were increases in the exports of agricultural tractors, excavating and earth moving machinery and internal combustion engines. Exports of electric machinery and apparatus increased by £7,000,000 ; there was no increase in the value of exports of generators, motors, transformers and switchgear, but exports of radio apparatus and valves increased by £5,500,000. Exports of road vehicles increased in total by 7 per cent, exports of cars and chassis increasing by 14 per cent ; changes in the exports of other categories of road vehicles and parts were comparatively small.

Unemployment

According to a statement issued this week by the Ministry of Labour, unemployment in Great Britain increased by 14,000 between September 14 and October 12, the wholly unemployed rising by 13,000 and the temporarily stopped by 1000. The total number of people registered as out of work on October 12 was 419,037, a figure which includes 7460 school leavers. Expressed as a proportion of the estimated number of employees, unemployment in October was 1·9 per cent, the same as in September. In October last year it was 2·3 per cent. The areas in which the percentage of unemployment was above the national average on October 12 are Scotland (4 per cent), Wales (3·4 per cent), Northern (3·1 per cent), North-Western (2·3 per cent) and South-Western (2 per cent).

The Ministry says that in the four-week period ended October 7, the employment exchanges filled 159,000 vacancies. The number of vacancies notified to the exchanges but still unfilled on October 7 was 246,000 ; that was 9000 fewer than a month earlier.

The Coal Board's Finances

Hitherto, the National Coal Board has issued a quarterly statistical statement of the " costs of production, proceeds and profit or loss of collieries." It has now been decided that this document shall appear at half-yearly intervals as results differ considerably between the respective quarters of a year. By submitting half-yearly statements, the Board thinks that a more realistic picture of its finances will be given.

The first of the statements in the new form covers the six-month period January to June of this year. It estimates that at the end of that period, the Board had a surplus on its revenue account of £1,058,027. In the first six months of this year, colliery profits before charging interest were £15,396,027, profits on open-cast working were £3,146,000, and on the Board's ancillary undertakings, £174,000. A deduction of £17,559,000 has to be made from the Board's total profit to meet interest payable to the Minister of Power.

The statement shows that during the period reviewed the cost of colliery operation amounted to £412,222,479, of which wages (including holiday and sick pay and allowances in kind) took up £240,248,893. During the six months, the average weekly cash earnings of all wage-earners at the collieries were £14 12s. 8d. The average weekly cash earnings of face workers were £16 16s. 11d. and of surface workers £11 14s. 8d.

Apprentice Exchange Scheme

The scheme for the exchange of engineering apprentices between Australia and Great Britain, which was initiated by the Adelaide Junior Chamber of Commerce and the British Junior Chambers of Commerce, is now entering its fourth year. The programme for each boy covers approximately nine to ten months and is based on his working at three or four places of employment comparable with the one to which he is apprenticed in his own country. During the period he is given normal apprentice training, as far as possible, and is paid at the prevailing apprentice rate. The selection of the apprentice from this country for Australia is undertaken through regional groups of the British Junior Chambers of Commerce. The winner is chosen from a group of regional finalists who are interviewed at Birmingham by a panel representative of management and trade unions.

For this year's award, for the first time, an appeal was made to industrial and commercial firms for financial assistance to operate the scheme. The organising committee was sufficiently encouraged by the response to this appeal that it proposes to make a further appeal in 1960 and in that year to make three awards. For 1960, the age limit for entrants has been revised and entries will be invited from three distinct groups of apprentices who will have completed their indenture contract on or before August 31, 1960. The three classes from which entries will be invited are : Technical Apprentices, who must be under twenty-three years of age on the date of entry, the award being a twelve months' visit to Australia ; Commercial Apprentices, who must be under twenty-three years of age on the date of entry, the award being a six months' visit to the U.S.A. ; Craft Apprentices, who must be under twenty-two years of age on the date of entry, the award being a six months' visit to Western Germany.

Full details may be obtained from the British Apprentice Award Committee, 95, New Street, Birmingham, 2.

Boiling Heavy Water Reactor at Halden

On October 10, King Olav V of Norway officially inaugurated the world's first boiling heavy water reactor at Halden in south-eastern Norway. This reactor, which was first proposed in 1955 as a joint Norwegian–Dutch undertaking, later expanded into a general E.N.E.A. project, other O.E.E.C. countries having expressed a wish to participate in the development of a design which it is hoped will be suitable for generating steam for industrial uses and for ship propulsion. The reactor, which became critical on July 29, is now undergoing tests at zero power. It is ultimately intended to develop a thermal output of 20MW which is to be used to produce process steam for a nearby paper mill.

THE Halden reactor, which was officially inaugurated on October 10, embodies a novel principle, namely the generation in the core of heavy-water steam. The heavy steam passes through a heat exchanger where it gives up heat to ordinary water which in turn is converted into steam. The heavy condensate is pumped back into the reactor to begin the cycle again, while the light steam is available for industrial use, in the present case in a paper mill belonging to A/S Saugbrugsforeningen. It is hoped eventually to generate a thermal output of 20MW in the primary circuit, producing primary steam at a saturation temperature of about 230 deg. Cent., corresponding to 30 atmospheres pressure.

Experience with boiling reactors has until now been confined to installations using light water as coolant and moderator. They require the use of enriched uranium as fuel, a fact which offsets the cheapness of the coolant. With heavy water reactors one can employ natural uranium, together with a proportion of enriched fuel if high power is to be reached with a small core. It was considered that the supply of such fuel would be much more certain. While in the present case the heavy water was supplied by the United States, this material could, if necessary, be produced fairly economically in Norway itself owing to the existence of cheap electric power.

The history of the project goes back to the spring of 1955 when a non-boiling pressurised reactor was first proposed as a joint Norwegian–Dutch undertaking. On March 20, 1956, the Norwegian parliament authorised the reactor plant which was to be sited at Halden near the Swedish border. In the same year, the O.E.E.C. Council formed a study group to examine the possibilities of constructing and operating prototype, testing, and research reactors of various kinds as joint European undertakings. This group recommended in March, 1957, a number of designs, including the Halden B.H.W.R. Two months later the Norwegian representative in the O.E.E.C. steering committee suggested on behalf of his government that the Halden reactor, then under construction, might be operated as an O.E.E.C. joint undertaking. Subsequently it was felt that as the scheme was to last for a limited period and only the running costs were to be provided by O.E.E.C., the cost of construction being borne by Norway, it would be unnecessarily cumbersome to set up a new *ad hoc* organisation. Responsibility for operation, it was decided, therefore, should rest with the Norwegian Institute for Atomic Energy (I.F.A.) and an international committee (the Halden Committee) should draw up a programme of research. An international technical group, the Halden Technical Group, should supervise the carrying out of this programme by a team of scientists and engineers employed by the Norwegian Institute. A three-year agreement to this effect was signed in Oslo on June 11, 1958, the signatories being Norway, Austria, Denmark, Euratom (on behalf of Belgium, France, Germany, Italy, Luxembourg, and the Netherlands), Sweden, Switzerland, and the United Kingdom.

Work at the Halden site began in July, 1955, and was substantially completed in the spring of this year. The total cost was 23,800,000 kronor, as follows: civil engineering, 2,800,000; mechanical engineering 6,650,000; electrical installation, 1,550,000; miscellaneous, 1,100,000; heavy water, 7,400,000 kronor; first uranium charge, 4,300,000 kronor.

The contractors included Kværner Brug A/S (reactor tank, primary system, air lock); Thunes Mek. Værksted A/S (secondary system, main heat exchanger, heavy water storage tank); U.K.A.E.A. Industrial Group (fuel); U.S.A.E.C. (heavy water), together with over thirty other Norwegian and foreign firms and organisations.

Site and Layout

The reactor hall is excavated in the side of a hill from the solid rock with a minimum of 35m of rock between the hall and the outside, and about 60m on top (Figs. 1 and 4). It is

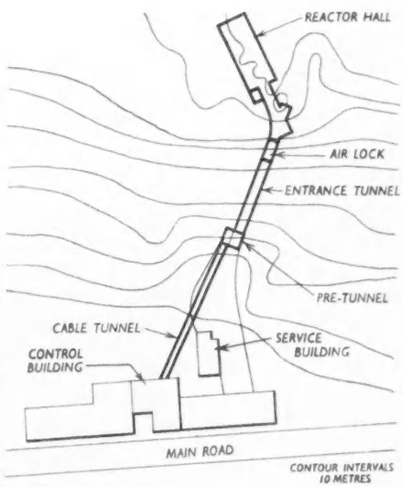


Fig. 1—Reactor site at Halden

rectangular in shape, lined with concrete throughout, and is approximately 10m wide by 30m long and 12m high above floor level (at 15·4m sea level) and 14m below. The hall is connected with the outside by a 60m long adit in which are placed two gas-tight doors forming an air-lock and designed to resist an internal pressure of 3 atmospheres. A system of water sprays is installed to quench any steam pressure building up in the hall.

The reactor itself is situated below floor level and is encased on all sides by concrete. Adjacent to it on one side, and situated on three levels below the hall floor, are the heavy water storage tank, heat exchangers and circulating pumps, and the heavy water purification plant. On the opposite side of the reactor are storage pits for "hot" fuel elements and the large reactor storage pit. All parts of the floor and sub-floor areas are served by a 50-ton travelling crane in the main hall.

Reactor

Our illustration, Fig. 2, represents a cross-sectional elevation of the reactor vessel which consists of mild steel and has an internal diameter of 270cm with a cylindrical internal height of 402·5cm, and 476cm from the flange to the domed bottom. Both the 70cm thick cover plate and the flange are mild steel forgings. While the cylindrical and the domed portions are 60mm thick with a 5mm thick stainless steel lining, the flange was covered with stainless steel by a welding process before being machined. The top plate and certain internal parts are nickel-plated.

The cover plate is bolted down by thirty-two studs of 142mm diameter which were tightened while being heated by internal heater elements. In the joint are two concentric aluminium gaskets, with an intermediate annular space which is connected to the heavy water leak system.

The lid has to be protected from radiation which would generate heat mostly in the part facing the core, and so would cause warping. This is avoided by interposing three plates of nickel-plated mild steel which are (top to bottom) 158mm, 100mm, and 35mm thick. To save heavy water, the bottom of the tank is occupied by a plano-convex filler lens made of nickel-plated boiler plate. On this rests the bottom core holder plate, also of nickel-plated mild steel.

The full power of the reactor, it is intended, will be reached in two stages for which the composition of the core will differ. On the conclusion of the zero power experiments it is planned at first to go up to 5MW, using a core containing about 7·4 tonnes of natural uranium. The core material is distributed over 325 rods of 1in diameter and about 2·4m long, clad in finned aluminium tubes. In addition, so as to increase the reactivity, there will be some enriched uranium oxide spikes clad in stainless steel. The fuel rods are attached to holders which pass through the top plate, forming a pressure-tight seal. The arrangement permits fuel rods to be withdrawn, when necessary, into a shielded coffin for transport by the overhead crane to the shielded storage space.

The core lattice is triangular, with a spacing of 130mm between the centres of the mesh. The fuel rods are located in holes in the bottom core plate in such a way that they can freely expand in the downward direction. Of a total of 16 tonnes of heavy water in the primary circuit, about 14·5 tonnes will be inside the reactor tank. In the first stage, the primary steam condition will be 150 deg. Cent. and 5 atmospheres. The plant can be operated at up to 250 deg. Cent. and 40 atmospheres pressure.

For powers above 5MW, for the size of core here employed it becomes necessary to use enriched uranium which will be in the form of oxide canned in "Zircalloy." The proportion of uranium 235 will be 1·5 per cent.

The reactivity is controlled by cadmium shim and scram rods of which ten are fitted at present, while nineteen to thirty may be employed at higher power. These rods are arranged in the same triangular mesh as the fuel. Each comprises a 184cm long cadmium tube of 50mm outer diameter encased in stainless steel. The control rod holders are taken through the lid. The external portion is enclosed in a pressure-tight thimble and carries an iron armature which can be moved up and down or held in position, by means of an external solenoid driven through gearing by a two-speed pole-changing motor, or in the case of a fine control rod, by a motor with smoothly variable speed. The arrangement fails "safe," for should the current in the solenoids be interrupted, the rods will drop into the core. To avoid the build-up of explosive mixtures of oxygen and hydrogen in the thimbles, these are vented through controlled leaks of sintered stainless steel to the leakage system.

The neutron flux is measured by boron trifluoride ionisation chambers of which four are fitted at present. At 5MW, the flux will be $0{\cdot}8\times10^{13}$ neutrons per square centimetre per second, while at the full power of 20MW the flux will increase to $5{\cdot}4\times10^{13}$ neutrons per square centimetre per second.

A system of cooling jackets, in which ordinary water is circulated, surrounds the tank at the sides and cooling pipes are also placed inside the concrete. The biological shield at the side of the tank amounts to 13cm of steel and 37·5cm

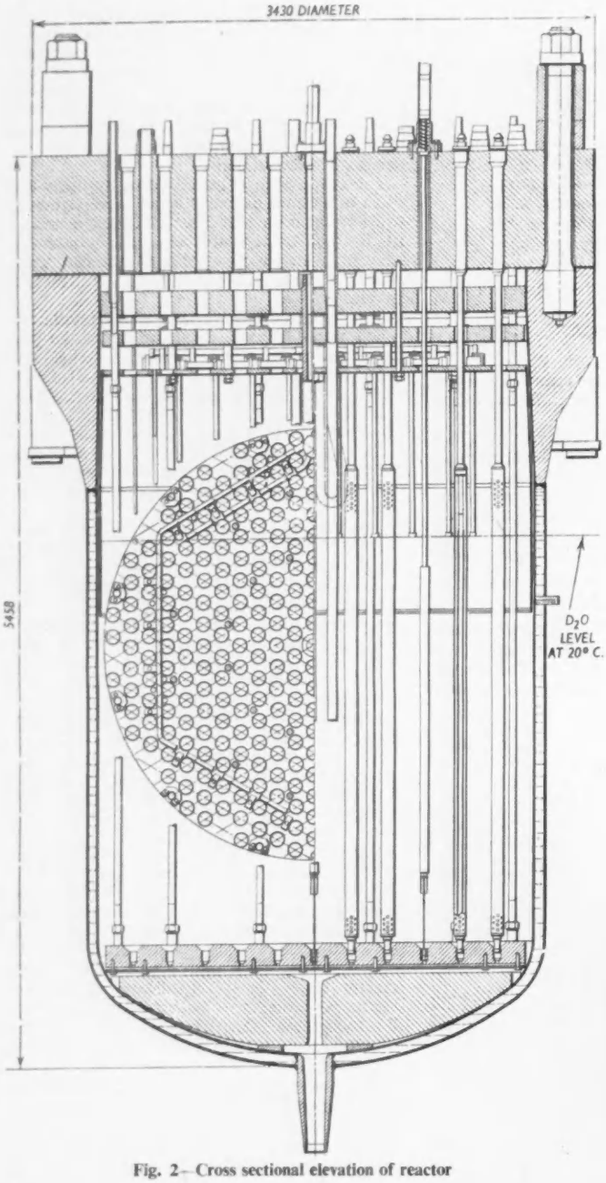


Fig. 2—Cross sectional elevation of reactor

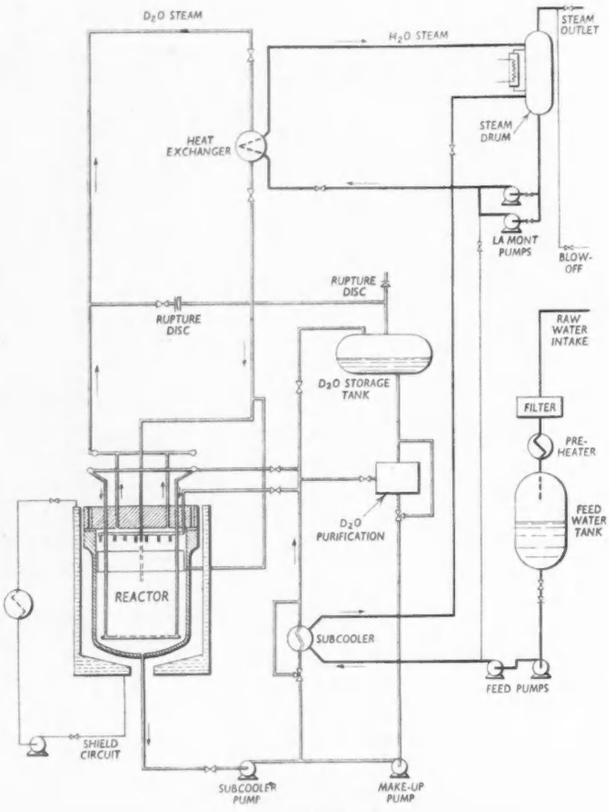


Fig. 3—Simplified flow diagram

of light water, plus 250cm of concrete. At the top, the total steel thickness is about 100cm, in addition to which there will be 200cm of concrete. At present the cover has the form of a concrete filled steel shell, but this will probably be replaced by a shield built up from smaller blocks.

During the next three to four months, the reactor will operate at "zero power"—a few watts—to enable certain measurements to be made during which contamination by fission products must be avoided. At this stage the reactor will not boil. Later, the heat flux from the fuel elements will be increased to 8W per square centimetre (at 5MW), and eventually, at the power level of 20MW, to 30W per square centimetre. The heat is abstracted by natural convection and in order to obtain a well-defined flow pattern the elements are surrounded by perforated shrouds. The mixture of steam and water rises inside and escapes through perforations at the top; the water falls back into the tank and returns to the bottom where it re-enters the shrouds through another set of holes.

Main Flow Circuits

The principal flow circuits are shown diagrammatically in Fig. 3. Heavy steam generated inside the reactor is taken out through holes in the lid and collected in a manifold from which it is naturally convected to the primary side of a steam "transformer" (heat exchanger). The design circulation is 8·6 tonnes per hour, and the temperature drop across the exchanger, 15 deg. Cent.; for full power, a second exchanger may be installed. All pipework in the heavy steam circuit is of internally nickel-plated mild steel. Heavy water pipes and fittings are of stainless steel, the high pressure valves bellows-sealed, and the pumps submerged.

Through absorption of radiation, a certain proportion of the total heat output, about 6 to 7 per cent, is developed outside the shrouds surrounding the fuel elements. Since the heavy

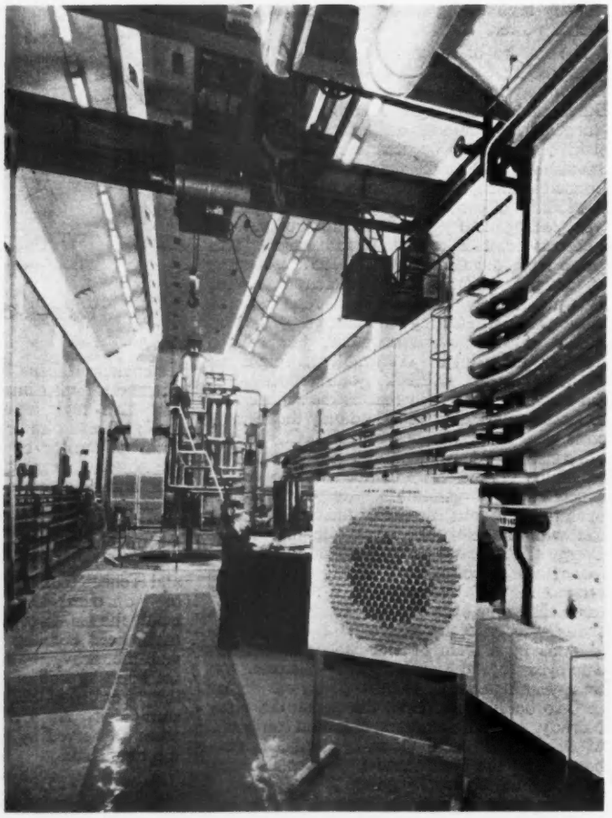


Fig. 4—The reactor hall seen from the tunnel. The reactor pit is in the middle of the floor, steam drum in the background. In the foreground is a board showing the present core loading

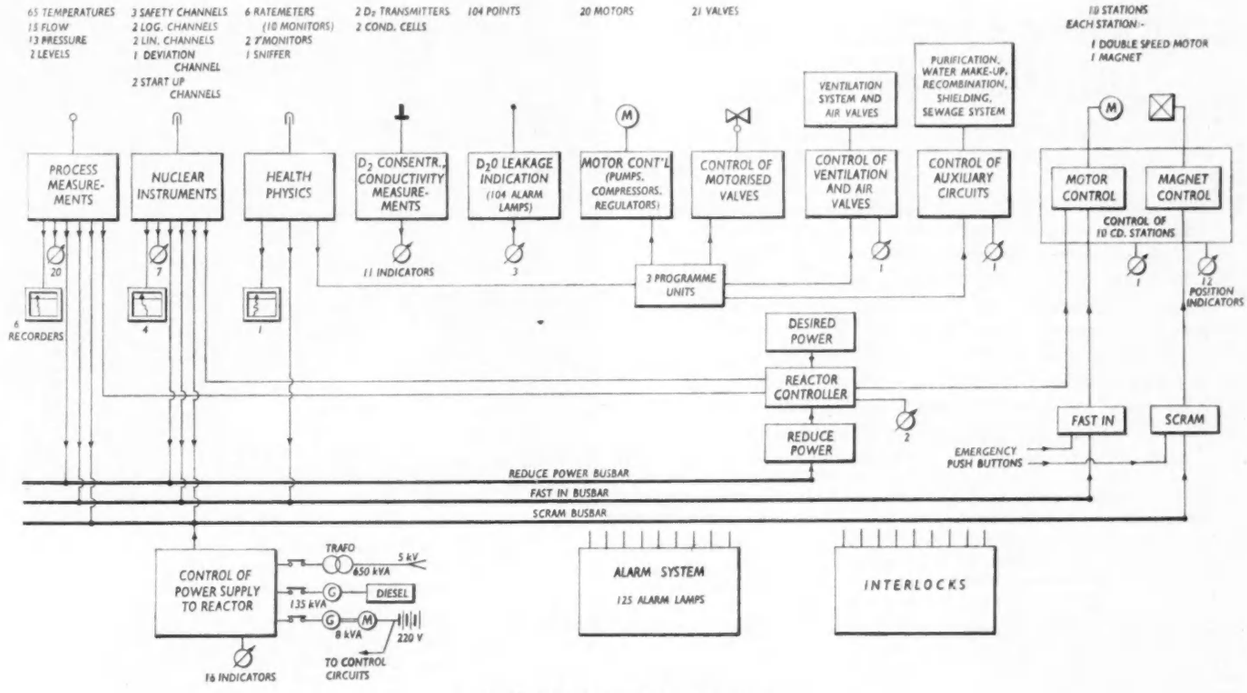


Fig. 5—Control circuits of Halden reactor

water is near its boiling point, boiling may take place outside the shrouds and lower the reactivity. A system for subcooling the water between the shrouds has therefore been installed. Water is withdrawn through a central pipe from the bottom of the reactor and after passing through a heat exchanger (subcooler) is returned either at the top of the reactor tank or the bottom, or both. For this purpose the reactor is fitted with a distributor manifold situated under the lid between the middle and lower radiation shields ; from this manifold, pipes descend to just below surface level. Secondly, there is a distributor space under the bottom core holder plate. The plate is drilled with suitable holes for spreading the flow.

The reactivity strongly depends on the exit steam void ratio which in the shrouds can be up to 50 per cent. This ratio is also indirectly controllable by the subcooler loop.

The secondary side of the subcooler operates with filtered, preheated and thereby de-gassed light feed water which is raised from 100 deg. Cent. to 135 deg. Cent., before being pumped to the water side of the steam drum. From here the feed is circulated by La Mont pumps to the secondary side of the steam "transformer"; the steam generated there is returned to the top of the steam drum to which the external steam line and the blow-off line are also connected. The La Mont pumps can also be used to circulate feed water through the subcooler, as well as the steam "transformer," a non-return valve preventing reverse flow into the feed water tank.

During operation of the reactor, the intense gamma radiation causes some of the heavy water to decompose into oxygen and hydrogen. These gases could cause corrosion, reduced heat transfer in the exchangers, and the formation of explosive mixtures. For that reason there is in the primary circuit a recombiner in which the gases from the condenser space are passed over a platinum catalyst and converted back into water which is returned to the main circuit. The flow in the recombiner circuit is obtained by suction from a venturi placed in the steam line.

For purifying the heavy water, a proportion is passed continuously through a by-pass in the subcooler circuit. Here, any products of corrosion and other impurities are removed by ion exchange. Since radioactive fission products accumulate in the ion exchanger, it is equipped with a radiation monitor.

All water which leaves the installation is checked for absence of radioactivity. Radioactive waste water first flows into a delay tank with a capacity of 260 cubic metres and from there into the public drains. Non-active water can be drained directly so as not to fill up the delay tank volume unnecessarily.

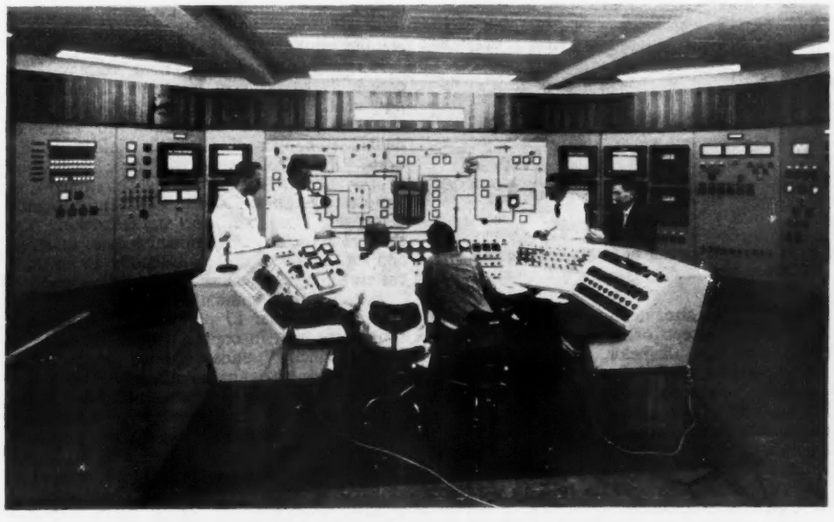


Fig. 6—Control room of boiling heavy water reactor at Halden

Control Installation

The reactor is remotely operated from a control room situated in a building near the entrance to the tunnel. Fig. 5 shows diagrammatically the controls, which are wholly electric. Control cables connecting the reactor with the control room, are the "reduce power bus," "fast-in bus," and "scram bus." Measurements of temperatures, pressures, flows, levels and radiation are recorded or indicated, while conductivity of the heavy water and any leakage are shown by indicators and warning lamps. Three programme units co-ordinate and operate the motors and valves of the control and cooling systems, the auxiliary and the ventilation circuits. These programme units obtain input signals from the health physics monitoring system. The reactor control system gets process and nuclear measurements, as well as signals from the operator setting the desired power level, and signals to reduce power from the plant over the "reduce power" bus. Its output is transmitted to the motor and magnet controls which alternatively can be operated by the "fast-in" and "scram" busbars and push-buttons. Control rod positions are indicated by an array of coloured lamps on the control panel. Correct operation is ensured by interlocks which are diagrammatically shown as a separate unit in Fig. 5, but which in reality form part of the various sections of the system.

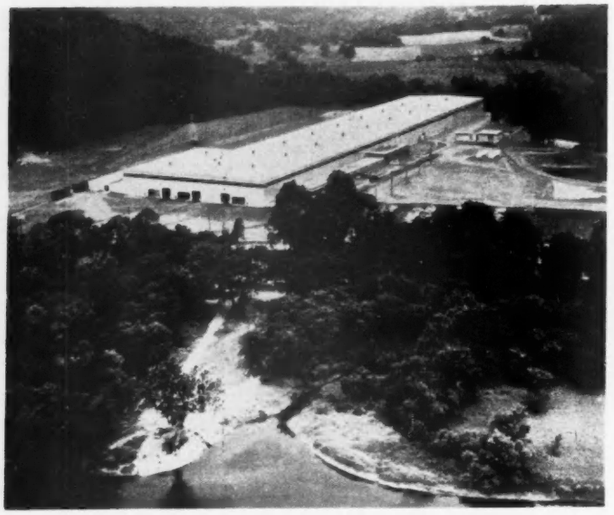
Normally, the current for the whole of the control system is supplied from the grid. Should an interruption occur, the reactor will automatically shut down through the cadmium control rods falling into the core. At the same time, the control system switches over to emergency power supplied by a diesel generator set and a battery operated motor-generator set. This keeps going the instruments and the principal circulating pumps.

Copper and Brass Tube Mill at New Milford

BY OUR AMERICAN EDITOR

No. I

The Scovill Manufacturing Company, of Waterbury, Connecticut, recently opened its new copper and brass tube mill situated on the Housatonic River at New Milford, Connecticut. The works comprise a 293,000 square feet main building situated on a 72-acre site. The mill has been set up with complete integral-unit work centres, instead of the usual "central process" operation with its duplication of similar equipment in one area. This streamlined layout results in a minimum of materials handling. The factory comprises three main bays which handle copper tube, heat exchanger tube and general commercial tube.



THREE years ago, the Scovill Manufacturing Company, of Waterbury, Connecticut, decided to establish new tube producing facilities to serve the broad plumbing, heating and air conditioning markets using various types of copper tube and pipe. At the same time, it was decided to redesign and modernise existing equipment and processes to produce tube serving fields using both heat exchanger and general commercial types of brass and cupro-nickel alloys. The firm's thirty-nine-years-old Waterbury tube mill could not be expanded at its old site, largely because of lack of space. The problem of developing the most efficient production facilities for copper and brass tube mill products was placed in the laps of the company's engineers. To achieve a modern, streamlined tube production layout, it was apparent that a long and relatively narrow building would be ideal. To obtain good machine and equipment service, a maximum bay width of 80ft was established. A height of 28ft to the crane rails permitted tube handling with tolerable end sag. The general layout fell into three crane bays—one for each of the three main tube categories: copper tube and pipe, heat exchanger tube, and general commercial tube.

Brass and copper tubes, because of their length and high surface finish, are difficult and costly to transport from one processing point to the next. The new mills have been set up with complete integral unit work centres, instead of the usual "central process" operation with its duplication of similar equipment in one area. This streamlined layout resulted in a minimum of materials handling and a surprising elimination of equipment duplication. The main pickle cross-bay area can receive and deliver tubes from both brass bays. The long bay-transfer conveyors, with their loading racks, speed delivery in either direction. Intermediate operations are zoned with annealing and pickling equipment in the centre of activity. This approach has been called "unitised" processing and it is visualised in the diagram (Fig. 1).

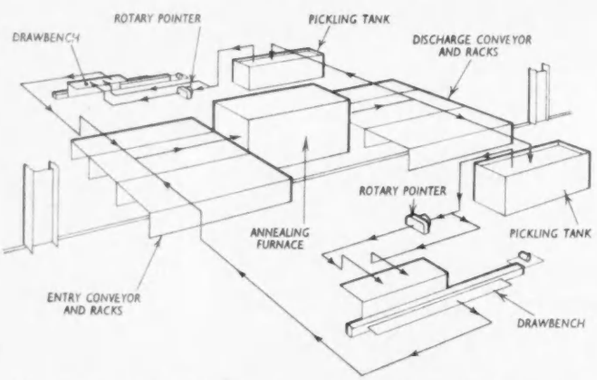


Fig. 1—Diagram of bay transfer conveyor system to facilitate "unitised" processing

The new five-at-a-time tube drawbenches at New Milford are of modern design. These benches can produce straight tubes up to 200ft long at rates not previously attained in the industry. To avoid tube surface defects due to handling, and to maintain high production rates, these benches are equipped with elevating discharge racks, making crane service between draws unnecessary. The large new rotary tube pointers operate automatically. The elimination of the usual manual method results in higher production but, more important, a more uniform high-quality point, while at the same time eliminating arduous manual labour. The pickling batteries were completely redesigned to get away from the common practice of still pickling. To clean the inside of long tubes of small diameter, the liquid is pumped through, as well as around, the tube. This is accomplished by pumping at a high velocity and maintaining a head at the entrance to the tube. The pickle cranes are equipped with two hoists to enhance further the agitation or turbulence and to facilitate tube drainage. All pickle batteries have three instead of the usual two clean water rinses to ensure acid-and-stain-free tubes. The mill employs a new tube tester which can handle up to 400 finished tubes per hour with a maximum length of 100ft. It is an automatic, combined hydrostatic and pneumatic tube tester providing a maximum air pressure of 500 lb per square inch and maximum water pressure of 7000 lb per square inch.

Range of Products

Under the heading of "Copper Tube and Pipe," the new mill produces copper water tube, copper drainage tube, copper threadless pipe, copper pipe, red brass pipe and copper refrigeration tube. The sizes manufactured range up to 6in diameter, except for refrigeration tube which ranges up to ¾in diameter.

The category of "general commercial tube" includes copper, gilding metal, commercial bronze, red brass, cartridge brass, Muntz metal, low-leaded brass, medium-leaded brass, high-leaded brass, leaded Muntz metal, oreide-brass, trumpet brass and naval brass (A). The sizes manufactured range up to 2½in diameter by 0·400in wall thickness.

"Heat exchanger tube" involves some of the most critical applications of non-ferrous tube and is one of the specialties of the firm. To achieve highest quality, Scovill has standardised on a range of tube diameters and wall thicknesses covering heat exchanger tube requirements most frequently specified. The firm supplies heat exchanger tube in sizes 2½in o.d. by ⅜in wall to ¼in o.d. by 0·025in wall, in lengths up to 100ft. A number of tube alloys are available for the various types of service found in power plant installations, oil refineries, chemical processing, &c. A brief description of these alloys and general applications follows.

Deoxidised Copper: Nominal composition: copper 99·90 per cent minimum, phosphorus 0·02 per cent. As indicated by the composition, deoxidised copper is commercially pure copper deoxidised with phosphorus. Tubes of this material have found wide usage in sugar refining, chemical processing, feed water heaters and condensers, and distribution lines for cold and hot waters in domestic and industrial installations. Deoxidised copper has excellent resistance to many chemicals, such as organic acids, alkalis and neutral salts, and fresh and salt water. Corrosion by acids and alkalis is more severe under conditions where solutions are aerated, where velocities increase or where considerable turbulence is experienced. Copper is not generally recommended for handling liquids, vapours, or gases having a relatively high concentration of hydrogen sulphide or similar sulphur compounds, or in installations where appreciable concentrations of ammonia or ammonium compounds are in contact with tubes. As indicated above, deoxidised copper is not suitable for use under conditions of relatively high fluid velocities or excessive turbulence. This grade of copper, in addition to excellent corrosion-resistance, has high thermal and electrical conductivity.

Arsenical Copper. Nominal composition: copper 99·40 per cent minimum, arsenic 0·35 per cent. Arsenical copper has corrosion-resistant properties comparable to those of deoxidised copper and is used in similar applications. Its chief advantages over deoxidised copper are a somewhat higher strength at temperatures up to 300 deg. Cent. and a slightly better resistance to erosion and corrosion. The thermal and electrical conductivities of arsenical copper, however, are considerably lower than the corresponding values for deoxidised copper.

Red Brass: Nominal composition: copper 85 per cent, zinc 15 per cent. Red brass is sufficiently high in copper content that it does not "dezincify" under normal service conditions; it is also not as susceptible to stress-corrosion cracking as brasses of lower copper content. Red brass tubes have served satisfactorily in condensers and heat exchangers in contact with fresh waters and also in uncontaminated salt water. This alloy is not generally recommended for use where corrosion by hydrogen sulphide or other similar sulphur compounds is liable to be severe, although it

has been used successfully in oil refinery applications, handling products of relatively low sulphur content. Red brass tubes were formerly used in installations where "dezincification" of the lower copper alloys was a major problem; with the development of inhibited admiralty metal, such as phosphorised admiralty metal, this latter alloy has replaced many of the red brass heat exchanger and condenser tube applications. Perhaps the major use of red brass tubes and pipe is now in distribution lines for cold and hot waters in domestic and industrial installations.

Phosphorised Admiralty (Type D): Nominal composition: copper 71 per cent, tin 1 per cent, phosphorus 0·03 per cent, zinc remainder. The addition of a very small percentage of phosphorus to admiralty metal increases the "dezincification"-resistance of the alloy to a marked degree without impairment of the excellent chemical and physical properties of the alloy. Phosphorised admiralty metal was developed, therefore, particularly for installations where severe dezincification of admiralty metal has been experienced or is anticipated. Combining, as it does, resistance to dezincification and resistance to corrosion by sulphur compounds, acids, contaminated fresh and salt waters, &c., phosphorised admiralty metal tubes have found general acceptance for condensers and heat exchangers operating under a wide variety of conditions. Generally, this alloy performs best with fluid velocities under 6ft–7ft per second.

Arsenical Admiralty (Type B): Nominal composition: copper 71 per cent, tin 1 per cent, arsenic 0·03 per cent, zinc remainder. Admiralty metal containing a small percentage of arsenic as an inhibitor has improved resistance to "dezincification" over that of the uninhibited alloy. Condenser and heat exchanger tubes of this alloy, therefore, are used for services similar to those outlined for phosphorised admiralty metal condenser tube applications. Under some conditions of service, however, particularly in contact with media slightly acid in character and at temperatures over 100 deg. Fah., arsenical admiralty metal may undergo a severe form of intergranular corrosion which may bring about accelerated failures as a result of stress-corrosion cracking or corrosion-fatigue cracking. Under such service conditions, phosphorised admiralty metal tubes are preferred to arsenical admiralty tubes.

Admiralty (Type A): Nominal composition: copper 71 per cent, zinc 28 per cent, tin 1 per cent. This alloy has given excellent service and has been used widely in tube form in such diverse services as steam condensers using fresh, salt, brackish or acid mine water for circulating purposes; heat exchangers, coolers, &c., in oil refineries where corrosion from sulphur compounds, acids and contaminated waters may be very severe; feed water heaters, heat exchanger equipment in industrial processes, &c. Admiralty metal tubes are often used in apparatus operating at temperatures of 400 deg. Fah. or higher, although severe "dezincification" of the alloy may be experienced under certain service conditions at elevated temperatures. Admiralty metal has a tensile strength of approximately 50,000 lb per square inch in the finish annealed condition, together with excellent ductility. The strength of the alloy is retained up to a temperature of approximately 570 deg. Fah. Since this alloy is subject to "dezincification" under certain service conditions, its use is limited to applications where experience has shown that "dezincification" is not a problem. In admiralty metal installations requiring high resistance to "dezincification," phosphorised admiralty metal is preferred.

Phosphorised Muntz: Nominal composition: copper 62 per cent, tin 0·3 per cent, phosphorus 0·07 per cent, zinc remainder. Phosphorised Muntz metal was developed to improve the "dezincification" of the alloy materially. This alloy, therefore, has very good resistance to corrosion by hydrogen sulphide and other sulphur compounds and relatively good resistance to "dezincification" and has been used in oil refinery equipment where this fault and sulphide corrosion have been major problems.

Muntz Metal: Nominal composition: copper 62 per cent, zinc 38 per cent. Muntz metal tubes have been used in both fresh and salt water service in steam condensers operating at relatively low temperatures. Use at the present time is confined chiefly to steam condensers at inland stations with fresh circulating water from rivers, lakes or wells. Muntz metal also has good resistance to hydrogen sulphide and other active sulphur compounds, but is seldom used in applications where corrosion by such compounds is severe, primarily because other factors, such as high temperature, high velocities, badly contaminated waters, &c., are usually active at the same time. Failure of Muntz metal tubes occurs usually as a result of gradual "dezincification"; therefore Muntz metal tubes are not generally used under service conditions when this problem may be serious. Phosphorised Muntz or phosphorised admiralty tubes are preferred for such installations.

Aluminium Bronze: Nominal composition: copper 95 per cent, aluminium 5 per cent. Tubes of this alloy have given excellent service in condensers of some tide-water stations using polluted salt water and brackish circulating water for cooling. On the other hand, the performance of aluminium bronze tubes has been disappointing in many similar applications. The alloy is subject to an unpredictable intensive localised pitting under certain conditions of service, which may lead to early failure. The use of aluminium bronze condenser and heat exchanger tubes, therefore, is usually limited to applications where long experience or actual tests in service have proved its corrosion-resistance.

Aluminium Brass: Nominal composition: copper 77 per cent, aluminium 2 per cent, arsenic 0·03 per cent, zinc remainder. The addition of approximately 2·00 per cent of aluminium to brass of the above copper content improves the resistance of the resulting alloy very materially, particularly to corrosion by salt and brackish waters and to combined erosion and corrosion in salt water service. The excellent corrosion-resistance of this alloy depends upon the nature of the film which develops over the surface of the tube. In service, this surface film is of the desired properties (thin, adherent, continuous, compact) to give excellent protection to the metal even under very severe water conditions; in addition, the film is self-healing in case of a local breakdown, such as might occur through abrasion or erosion of the metal surface, making tubes of this alloy very serviceable in installations where tubes of other alloys might suffer rapid local corrosion or erosion. Aluminium brass tubes have been used quite extensively in marine condensers and in steam condensers of tide-water stations where relatively high velocities of the circulating water, together with turbulence and air bubble impingement, have a particularly severe local wearing action on admiralty metal and other brass tubes. Tubes of this alloy have also given good service in many oil refinery applications.

Cupro-nickel, 30 per cent: Nominal composition: copper 69·5 per cent, iron 0·50 per cent, nickel 30 per cent. Tubes of this alloy are used in heat exchanger equipment under conditions where severe erosion and corrosion have been experienced, particularly at elevated temperatures and at high velocity and turbulence of the circulating media. Cupro-nickel tubes have given excellent service, for example, in ship condensers of the U.S. Navy, in steam condensers of tide-water stations where brackish or salt circulating waters are very corrosive, in feed water heaters, and in various oil refining units operated at relatively high temperatures and in contact with corrosive materials. Cupro-nickel, 30 per cent, combines excellent corrosion-resistant properties with very favourable physical characteristics, such as high strength and good ductility. The strength of the alloy is retained even at relatively high temperatures. Cupro-nickel tubes are not usually subject to season cracking or stress-corrosion cracking, so that they may be used with reasonable safety either in the finish annealed or hard drawn condition. The preference at the present time is for finish annealed tubes.

Cupro-nickel, 20 per cent: Nominal compo-

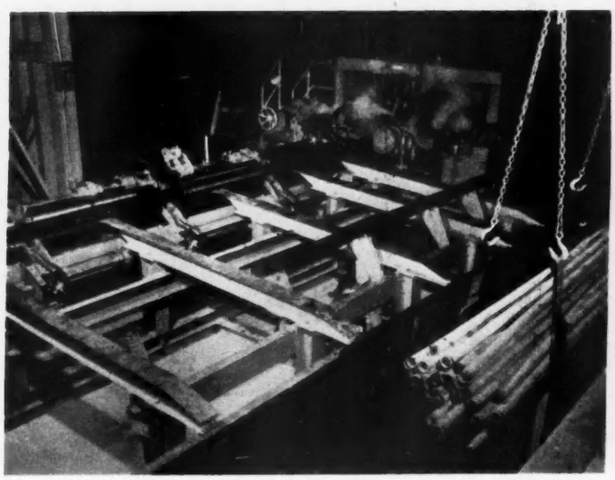


Fig. 2—19in hot billet piercing mill for copper shells, with water bosh tank in foreground

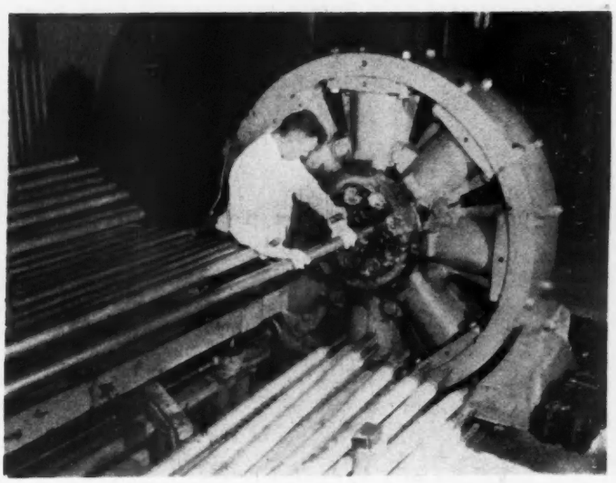


Fig. 3—600-ton hydraulic squeeze pointer for processing pierced shells

sition : copper 80 per cent, nickel 20 per cent. The copper-nickel alloy containing 20 per cent nickel has similar physical and chemical properties to the cupro-nickel, 30 per cent, and is, therefore, used in the same kind of service. The corrosion-resistant properties of the alloy are not equal to those of the higher nickel alloy, so that the 30 per cent alloy is still generally used under extremely severe conditions. In many cases, however, conditions may not be severe enough to justify the use of cupro-nickel, 30 per cent, and in such cases cupro-nickel, 20 per cent, may give economical and satisfactory service.

Cupro-nickel, 10 per cent : Nominal composition : copper 88·75 per cent, iron 1·25 per cent, nickel 10 per cent. Tubes of this alloy have shown excellent resistance to corrosion by sea and brackish waters. This material also has high resistance to erosion-corrosion and air-impingement attack. Many experimental corrosion tests and numerous actual service installations have shown that the cupro-nickel 10 per cent alloy is at least comparable to and, under many service conditions, superior to cupro-nickel, 30 per cent tubes in condensers and heat exchangers in salt water service. Cupro-nickel, 10 per cent, and the other cupro-nickel alloys have a very high resistance to stress-corrosion cracking and very seldom fail from this cause in service. The U.S. Navy is now using the cupro-nickel 10 per cent alloy in place of cupro-nickel 30 per cent, for condenser tubes and salt water piping. This alloy has only fair resistance to corrosion by hydrogen sulphide and similar sulphur compounds ; its use under conditions where such compounds are present, such as in oil refineries, is not recommended except after a thorough trial. Also, cupro-nickel 10 per cent alloy tubes might not give satisfactory service in contact with waters having relatively high sulphide content, such as waters polluted with industrial wastes or sewage. Cupro-nickel 10 per cent alloy, like the other cupro-nickel alloys, has good strength and excellent ductiliy at ordinary temperatures and relatively high strength and other favourable mechanical properties at elevated temperatures. Thus, the cupro-nickel alloys may be used in high temperature applications, such as high pressure, high temperature feed water heaters.

In addition to the materials already discussed, " duplex " tubes are available in many combinations. " Duplex " tubes are manufactured by mechanically bonding tubes of two different metals or alloys so that they are in intimate contact. In this way, it is possible to choose various combinations of ferrous or non-ferrous alloys to combat successfully a certain kind of corrosion at the outside surface and an entirely different kind of corrosion at the inside surface. As an example, in ammonia refrigeration systems, " duplex " tubes having steel on the ammonia side and a copper alloy material on the water side can be produced to provide excellent service. The copper alloy material alone would have poor resistance to ammonia, and steel on the water side would be liable to severe corrosion.

Where contact of the ends of the outer tube with the fluid passing through the tubes is considered objectionable, these ends may be replaced with ferrules of the same alloy as that of the inside tube. These ferrules need be only long enough to ensure their being held in place when the tube ends are rolled into the tube sheets. In this way the only joint between the two alloys is sealed within the tube sheet. It is a distinct advantage to have these ferrules furnished as an integral part of the tube to facilitate installation.

Design of Tube Mill Building

The tube mill building is 293,000 square feet in area and 1150ft in length. The walls are of prefabricated " sandwich " metal panels with an exterior aluminium face and insulated with glass-fibre. A translucent band of green-coloured " Corrulux " admits light and sets off to advantage the appearance of the building. The office building, service department, electrical equipment and boiler room join the mill building and are one storey in height, extending 432ft along the side of the main buildings. The interior is attractively decorated, and air conditioning is provided for the office section.

The mill building was designed with a structural steel frame three bays wide with a craneway provided in each of the three bays. The two outside bays have a 62ft 5in span and the middle bay has a clear span of 80ft 6in. Due to economical design there are only 2342 tons of structural steel in the mill building frame. Heavy concrete foundations were necessary for the drawbenches, annealing furnaces and pickle pits. One of these foundations for the 50,000 lb drawbench is 480ft long, while the other foundations vary from 150ft to 200ft. Because of the lack of city water and inability to get sufficient water from wells, it was necessary to construct a pump house with three 1500 g.p.m. pumps. A 24in intake pipe was extended 700ft to an island in the Housatonic River in order to obtain sufficient process water. This process water must be discharged back into the river after the proper chemical treatment. To obtain this result a complete auto-chemical treatment plant was constructed, together with large equalising and sludge lagoons.

The entire mill building is protected by an automatic sprinkler system. To make this system workable, it was necessary to connect the sprinkler mains to the process water main and a concrete reservoir constructed on the hill adjacent to the building site. This reservoir has a capacity of 100,000 gallons and supplies the sprinkler system at 80 lb per square inch.

Structural Steelwork.—In planning the structural steelwork, the greatest saving in weight, and consequently in money, was obtained from cantilevering the centre aisle truss into the side aisles. This truss overhangs the columns by 16ft. The side trusses span 46ft instead of the full 62ft width, and the cantilever effect also reduces the stresses in the centre truss. This arrangement saved 118 tons of steel or of the weight of the main building steel.

Along one interior column line several columns had to be eliminated to facilitate material transfer or equipment layout. The head-room requirements permitted 12ft deep trusses under each crane rail. Acting in pairs, these trusses supported both cranes and roof. Each truss of the pair weighed 11 tons and was the heaviest individual member erected.

The crane runways and rails are part of the building steelwork requiring periodic maintenance because of wear. An experiment is being made on the East aisle crane runway with a view to prolonging the life of the rails. Rail wear is most pronounced at the joints which open and close due to temperature changes and tractive crane forces. In this experiment the rails have been tightly butted and welded so that they are continuous for the building length of 1150 ft. The rail clamps have a small clearance so that the rails can move relative to the girders which are divided into four units by expansion joints. It is too early to reach any conclusion about this experiment ; probably five years will be required. Replacing rails is an expensive job, and an increased rail life of a very few years will more than offset the extra cost of the field welding.

Building Sidings.—The aluminium walls of the building were designed to simulate leather graining. Besides striking beauty, this relatively new building material provides years of trouble-free service, being virtually impervious to the action of weathering. These exterior side walls were applied over 92,100 square feet of 3¼in field-assembled, insulated side wall. The aluminium facing is of 16 gauge sheet and was erected on the job in the form of 12in panels, mounted on 24in sheets forming the inside facing. The inside facing is of 18 gauge galvanised and painted steel. During the erection, the inside wall plates were placed vertically with the flat side in, and then clip welded to the structural members of the building which form the sill, intermediate girts and the eave strut. Each plate is interlocked with the preceding plate: 1½in of glass-fibre insulation was placed between the ribs of the inside wall plates. The external aluminium treatment provided for the main structure was also carried out for the process water pumping and waste water treatment buildings. The 7ft by 10ft louvred openings in the main building include aluminium louvres which may be manually operated for ventilation.

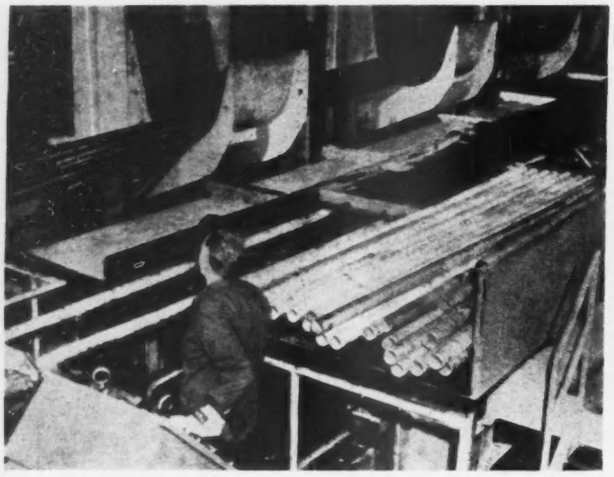


Fig. 4—15,000 lb double-chain drawbench with tube elevator to move drawn tubes from the discharge pit to the re-draw position

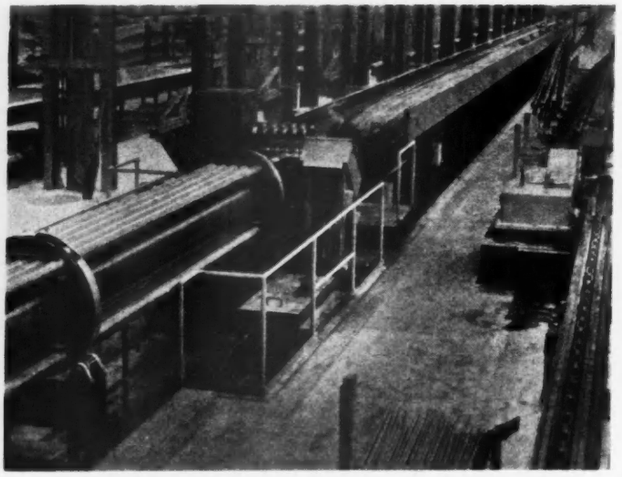


Fig. 5—50,000 lb dual-chain drawbench capable of drawing five 200ft long tubes simultaneously

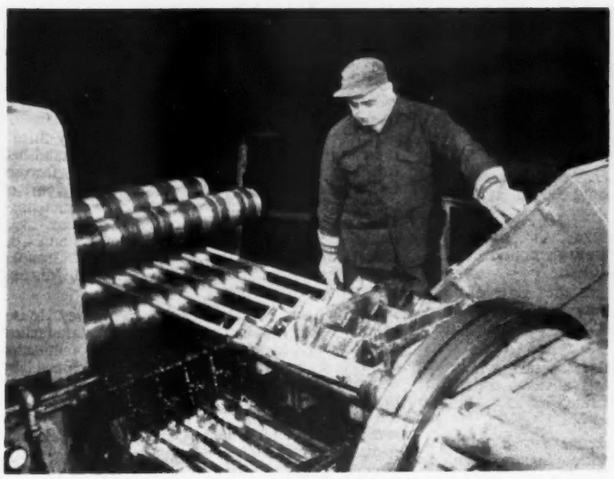


Fig. 6—Die stand of 50,000 lb dual-chain drawbench with pinch roll stand for loading tubes over mandrels

Fig. 7—Surface combustion direct-fired bright annealing furnace for brass and cupro-nickel tubing

PIERCING, POINTING AND DRAWING PLANT

The Aetna-Standard Engineering Company, of Pittsburgh, Pennsylvania, supplied all the new piercing, pointing and drawing plant at New Milford. The piercing mill takes heated copper billets and feeds them through 19in diameter convex tapered work rolls and over a mandrel, thus forming a hollow shell. The machine is powered by an 800 h.p. motor and will handle copper billets 3in to 6in in diameter by 72in maximum length. It will produce pierced shells 3in to 6in diameter by 21ft maximum length. Fig. 2 shows the outlet table end of the machine with a pierced shell emerging from the work rolls and being supported by the guide rollers. Pierced shells are being held on the outlet skids while a load is removed from the water bosh tank.

A 600-ton hydraulic squeeze pointer is used to point the pierced copper shells prior to the cold drawing operation. The shells are fed into the stepped dies and squeezed by the radially mounted cylinders under high pressure, as shown in Fig. 3. This machine will handle tubes up to 10in diameter with a 1in wall. The 3in pierced shells are pointed to 1¼in diameter.

The 150,000 lb double-chain drawbench with its accompanying reload rack is the first installation of its kind to be put into operation in the United States. The pointed pierced copper shells are reduced by cold drawing on this machine with a minimum amount of handling and loss of production time for die changes. The machine is powered by a 500 h.p. motor and can draw five 75ft long tubes at a time at a maximum speed of 225ft per minute. Fig. 4 shows the operator's pulpit with the loading trough in the centre and two tubes being pushed over the mandrel rods. The reload rack is in the background with a load of tubes being taken away. Tubes can also be redrawn on the machine without any crane handling being required.

The 50,000 lb dual-chain drawbench with its accompanying reload rack is the longest installation of its kind in operation in America. Tubes are received from the 150,000 lb drawbench and are given several more draws. The reload rack enables the operator to perform several drawing operations without requiring any overhead crane handling. This machine is powered by a 300 h.p. motor and can draw five 300ft long tubes at a time at a maximum speed of 450ft per minute. Fig. 5 is an overall view of the machine with the mandrel rod end in the left foreground, the operator's pulpit, pinch rolls and die stand in the centre and the loading deck and reload rack extending into the background. The tubes are loaded on the mandrels by the pinch rolls, then rotated and pulled through the dies by the carriage.

The 50,000 lb single-chain drawbench is used to perform further reductions on the tubes drawn on an older 100,000 lb drawbench. This machine is powered by a 200 h.p. motor and can draw three 60ft long tubes at a time at a speed of 130ft per minute. Finally, the 50,000 lb dual-chain drawbench is used to finish brass condenser tubes. It is powered by a 300 h.p. motor and can draw five 100ft long tubes at a time at a maximum speed of 400ft per minute. Fig. 6 shows the operator's position as seen from the die stand of this machine, with the pinch rolls ready to load five tubes on the top set of mandrels while a like number are being drawn through the dies below.

The Westinghouse Electric Corporation supplied the complete electrical equipment to drive the 150,000 lb single-chain drawbench and the two 50,000 lb dual-chain drawbenches. The 150,000 lb single-chain drawbench is powered by a non-reversing 500 h.p., 450/900 r.p.m., 600V d.c. motor. This motor has "thermalastic" insulation.

The carriage return is powered by a 25 h.p., 68/136 r.p.m., 230V d.c. geared motor. The d.c. power sources for these drives include a 400kW motor-generator set with an extended bedplate. Mounted crosswise on this extended bedplate is a 25kW, two-unit motor-generator set for the carriage drive. Also mounted crosswise is a four-unit exciter motor-generator set. This complete power system is enclosed in a sheet steel housing which has filtered air inlets on the sides with air discharge out of the top.

The d.c. adjustable voltage control components are fitted in a floor-mounted cabinet with resistors mounted and wired in a ventilated enclosure on top. This cabinet is matched and in line with the power source housing. All the interconnections between the control, the exciter and power sources are integral in the housing. This arrangement substantially reduced installation costs, since most of the interconnection wiring is inherent in the package drives. Furthermore, there are no special requirements for the power source, such as foundations or motor room construction. The starter for the a.c. drive motor on the main power source is also in a floor-mounted cabinet. This starter is integral with the control package. The package arrangement is the largest manufactured by the Westinghouse Electric Corporation.

The two 50,000 lb dual-chain drawbenches are reversing drives with lower power requirements. Each drive is powered by a 300 h.p., 500/1200 r.p.m., 250V d.c. motor. This motor also has "thermalastic" insulation. The d.c. power source is a 300kW motor-generator set with an extended bedplate. Mounted crosswise on this extended bedplate is a three-unit exciter motor-generator set. This complete power system is also enclosed in a sheet steel housing. In addition, this drive has a static "Mag-amp" voltage regulator on the 300kW generator to provide current limit acceleration and deceleration. Provisions are made for recalibration of the current limit circuit to provide a high current limit setting for acceleration and for deceleration in the return direction, a low current limit setting for stall torque with the carriage against the die stand and a moderate current limit setting for deceleration after the completion of the draw. On this drive, the starter for the a.c. drive motor on the main power source is also in a cabinet integral with the control "package."

ANNEALING FURNACES

Considerable thought was given to the annealing facilities to be installed at New Milford. The Surface Combustion Corporation, of Toledo, Ohio, and engineers of Scovill co-operated in designing the heat treating equipment to carry out newly developed concepts of production, incorporating the most advanced methods of heat treatment control. The two main units used for processing brass and cupro-nickel tubing are atmosphere-controlled, continuous roller hearth annealing furnaces. One of the furnaces, which is situated in the "redraw" line, is direct-fired and is 92ft long. The other furnace, which is convection-heated, is 72ft long and is situated in the finishing line.

The direct-fired furnace (Fig. 7) will heat 15,000 lb of brass or cupro-nickel tubing at temperatures ranging from 375 deg. Cent. to 820 deg. Cent. and has facilities within the furnace to pre-cool the tubing to 120 deg. Fah., using a special pre-cool and fast-cool chamber at the discharge end. A "Surface DX" generator of 15,000 cubic feet per hour capacity is used to provide protective atmosphere, when needed. When bright annealing of brass or cupro-nickel tubing is necessary in this furnace, mixers can be set to obtain a richer mix, and additional generated "DX" gas is piped into the furnace. Special precautions have been taken to provide an atmosphere-tight furnace. Both vestibules are provided with baffles to prevent the escape of furnace atmosphere and to provide a positive pressure in the furnace. This positive pressure is sufficient to purge the inside of the tubing being processed, thus providing controlled surface conditions on the inside and outside of the tubing.

To maintain surface conditions and proper physical properties, pre-cool and fast-cool chambers are situated just inside the discharge end. Tubing placed on the charge table outside the furnace, passes continuously through the heating chamber, the pre-cool chamber, the fast-cool chamber and then to the discharge table. The rollers on the charge table, in the furnace and on the discharge table are synchronised and driven by a chain and sprocket assembly. This gives uniform speed to the various rollers and provides positive movement of the work through the furnace without damaging the tubing surface. Four round chart indicating controllers and a four-point strip chart recorder control the temperatures in the furnace, and four high temperature cut-off instruments also provide over-heat safety. A strip chart speed recorder and controller governs the speed of the furnace conveyor. All these instruments are mounted on a panel conveniently situated near the furnace operator's station.

(*To be continued*)

Personal and Business

Appointments

MR. J. C. G. WEGERIF has been appointed a director of Dowty Group, Ltd.

MR. G. C. PANES has been appointed London manager for Hopkinsons, Ltd.

MR. A. F. BURTON has been appointed general sales manager of Charles Colston, Ltd.

MR. J. A. HARLEY has been appointed deputy managing director of Steele and Cowlishaw, Ltd.

MR. AIREY NEAVE has been appointed to the main board of directors of John Thompson, Ltd.

MR. S. HALLAM has been appointed manager of David Brown Construction Equipment, Ltd., Meltham.

UDDEHOLM, Ltd., announces that Mr. A. G. Shaw, senior Midland area representative, has been promoted to Midland area manager.

MR. L. SCHEPERS has been appointed chairman of Shell Chemical Company in succession to Mr. F. A. C. Guepin who retired in June.

LORD BAILLIEU, president of the Dunlop Rubber Company, has been elected as the first president of The British Institute of Management.

MR. HARRY GLOVER has been appointed area sales manager for the Midlands for Dowding and Mills, Ltd., with effect from November 2.

MR. I. W. READMAN has been appointed aircraft production manager at the King's Norton, Birmingham, factory of the Triplex Safety Glass Company, Ltd.

SHEEPBRIDGE EQUIPMENT, Ltd., has announced the appointment of Mr. J. G. Francis as its technical representative for the Yorkshire and Lincolnshire areas.

C.A.V., Ltd., announces the appointment of Mr. A. E. W. Austen, A.M.I.E.E., as chief engineer. Mr. W. E. W. Nicolls has been appointed chief engineer for overseas operations.

FRED MYERS, Ltd., has announced that Mr. P. E. Fleming has relinquished the position of sales director and has accepted the appointment of director responsible for agricultural activities.

DEWHURST AND PARTNER, Ltd., announces that Mr. R. A. Gilbey has been appointed general manager, Amersham Works, and Mr. E. Ford has been appointed northern regional manager.

THE BRITISH TRANSPORT COMMISSION has nominated Mr. T. S. Roberts, chief docks manager at Hull, to the Coastal Shipping Advisory Committee to replace Mr. H. L. Hopkins, who has resigned.

MR. J. E. SMITH is to take up the position of managing director of the National Gas and Oil Engine Company, Ltd., on January 1, 1960. He will also become a member of the board of Hawker Siddeley Industries, Ltd.

MR. MICHAEL C. POTTS and MR. PETER SHARP have been appointed directors of Dowty Mining, Ltd., of Ajax, Ontario, a member company of the Dowty Group of Cheltenham. Mr. Sharp has also been appointed general manager.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., announces that Mr. Michael J. S. Clapham has been appointed chairman of the metals division from January 1, 1960, in succession to Dr. Maurice Cook, who retires from the company's service on December 31, 1959.

DAVID BROWN INDUSTRIES, Ltd., announces that Mr. Albert Maugham, deputy general manager of the machine tool and tool divisions, has retired on reaching the age of sixty-five, though his services will continue to be available to the company on a part-time consultative basis. Following Mr. Maugham's retirement Mr. W. F. Howe has been appointed manager of the tool division.

MR. WALTER ANDERSON GALBRAITH, A.M.I.Mech.E., has been appointed general sales manager of the Yale and Towne Manufacturing Company's British materials handling division at Wednesfield. Mr. Harry Davis has been appointed sales manager (United Kingdom), and Mr. Michael John Stuart, sales manager (export). All these appointments are effective from November 1.

MR. C. W. A. PRIEST, A.M.I.Mech.E., A.M.I.E.E., has been appointed chief design and construction engineer of the Central Electricity Generating Board, in succession to Mr. E. S. Booth, M.I.Mech.E., M.I.E.E., who has been appointed a full-time member of the Board. Mr. V. J. Speller has been appointed chief assistant public relations officer in succession to Mr. Peter J. Field, who has been appointed public relations officer.

Business Announcements

SAVILLE (TRACTORS), Ltd., has opened new offices and showrooms for the London area at Staines Road, Feltham, Middlesex.

BAILEY METERS AND CONTROLS, Ltd., states that the telephone number of its Birmingham branch office has been changed to South 4161–2.

SQUARE D, Ltd., states that the address of its Birmingham field office is now 751, Bristol Road South, Northfield, Birmingham, 31 (telephone, Priory 1163/4).

MR. MICHAEL GEORGE COHEN is taking up residence in the United States as a vice-president of George Cohen 600 Incorporated of 30, Church Street, New York.

THE ASSOCIATION OF HYDRAULIC EQUIPMENT MANUFACTURERS, 38-40, Eccleston Square, London, S.W.1, has been formed by British hydraulic equipment manufacturers.

G. A. HARVEY AND CO. (LONDON), Ltd., states that Mr. D. K. Fraser, M.I.Mech.E., M.I.Mar.E., at present managing director of Petters, Ltd., will be joining its board of directors in the near future.

MESSRS. J. D. AND D. M. WATSON, 67, Tufton Street, Westminster, London, S.W.1, chartered civil engineers, announce that they have taken into partnership Mr. Graham S. G. Goode, A.M.I.C.E.

HOLMAN BROTHERS, Ltd., Midlands branch is now accommodated in new premises at Lightning Way, Alvechurch Road, West Heath, Birmingham, 31. The new branch sales manager is Mr. C. E. J. Bishop.

SOUTHERN INSTRUMENTS, Ltd., has opened a northern branch office at 536, Rochdale Road, Shaw, near Oldham, Lancs (telephone Shaw 7343). Mr. G. Schofield has been appointed northern area sales manager.

MR. J. HUGH NEILL, deputy chairman and joint managing director of James Neill and Co. (Sheffield), Ltd., has left for a six-week tour of agents and customers in Canada, the U.S.A., Mexico and the Caribbean.

WEIR N.V., the Netherlands subsidiary of G. and J. Weir, Ltd., has acquired the business of N.V. "Warmtekracht," at Sluisjesdijk 131, Rotterdam-22, and has moved its headquarters in the Netherlands to that address.

SMALL AND PARKES, Ltd., has installed Telex at its registered offices and works, Hendham Vale, Manchester, 9, and at its London office, 251, Kingston Road, S.W.19. The numbers are Manchester Telex 66161 and London Telex 25439.

THE ENGINEERS' GUILD, Ltd. (incorporating the Professional Engineers' Appointments Bureau) states that the Guild office, including the appointments division, is now at 201, High Holborn, London, W.C.1. (telephone Holborn 1057).

BRITISH INSULATED CALLENDER'S CABLES, Ltd., announces that its depot at 58-59, Regent Street, Plymouth, has been made into an independent branch. The telephone number of the Worcester branch has been changed to Worcester 26966-7.

CASS ELECTRONICS, Ltd., White Hart Yard, Guildford Street, Chertsey, Surrey, has opened a showroom for the demonstration of "Nira Tele-Tracer" staff paging systems and "Dialog" instant intercom. equipment. The company's telephone number has been changed to Chertsey 3481 (2 lines).

DAVID BROWN INDUSTRIES, Ltd., states that the Spanish Government has approved the formation of a company to be known as David Brown Engranages S.A., which will undertake manufacture of commercial vehicle gearboxes and gears of David Brown design in a new factory at present under construction at Villaverde, near Madrid.

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, Ltd., Rugeley, Staffordshire, has introduced a planned maintenance scheme for customers in the United Kingdom. The scheme, which will be operated by the service and field operations department, involves four visits per annum and will be undertaken on a two-year contract basis with annual payments.

A.E.I. LAMP AND LIGHTING COMPANY, Ltd., states that its lamp and lighting sales departments have been integrated and at the same time a combined lamp and lighting marketing department has been set up. Mr. H. G. Lilley has been appointed sales manager and Mr. W. C. Huston, marketing manager. A combined lamp and lighting export department has been set up at Melton Road, Leicester, with Mr. G. O. Sparks as manager.

POWER CONSTRUCTION, Ltd., 19, Berkeley Street, London, W.1, is a new consortium of established British companies, formed to design, manufacture, deliver and construct power stations in any part of the world. The members of the consortium are: The Armfield Hydraulic Engineering Company, Ltd.; Belliss and Morcom, Ltd.; Cory Brothers and Co., Ltd. (a member of the Powell Duffryn Group); Lancashire Dynamo Holdings, Ltd., and Mitchell Engineering Group, Ltd.

FIRTH CLEVELAND PUMPS, Ltd., Stornoway House, Cleveland Row, London, S.W.1, is to manufacture under licence the range of self-priming multi-stage centrifugal pumps designed and developed by Dickow-Pumpen, of Wailkrayburg, near Munich, in Western Germany. The British company will sell the pumps in all parts of the world, with the exception of the Common Market Countries, Scandinavia and India.

GATE ELECTRONICS, Ltd., is moving into a new factory at Mayland Avenue, Hemel Hempstead, Herts, telephone number Boxmoor 6464. The building provides 30,000 square feet of production space as well as development laboratories and offices. It will provide facilities for the manufacture of the Gate telephone answering machine and television distribution amplifiers, and for contract work.

LAFARGE ALUMINOUS CEMENT COMPANY, Ltd., 73, Brook Street, London, W.1, has been appointed main distributor of the first British-made Super Sulphated Cement. This cement is made by Frodingham Cement Company of Brigg Road, Scunthorpe, from a granulated slag of unusually consistent composition from the works of Appleby Frodingham Steel Company, and it is claimed that this slag gives a cement of dependable quality and performance, which hardens at approximately the same rate as Portland cement and has a very high resistance to sulphates, sea-water, oils, fats and dilute acids. A low heat of hydration is also claimed.

Contracts

G.W.B. FURNACES, Ltd., has received from Henry Wiggin and Co., Ltd., an order for a packaged boiler installation consisting of five model 600 "Powermaster" packaged automatic oil-fired boilers capable of producing from 4000–104,000 lb of steam per hour at an efficiency of over 80 per cent.

HALL, RUSSELL AND CO., Ltd., has received an order for two trawlers, one from the Saint Andrew's Steam Fishing Company, Ltd., and the other from the Carry On Fishing Company, Ltd. Both ships will measure 115ft 6in by 26ft by 13ft 3in and be propelled by a Mirrlees mark K.S.C.D.M.6 turbocharged diesel engine.

THE GOOLE SHIPBUILDING AND REPAIRING COMPANY, Ltd., announces the receipt of an order from the Saint Andrew's Steam Fishing Company, Ltd., for a trawler having dimensions 182ft 6in by 32ft by 16ft 3in, a fishroom of 18,300 cubic feet capacity and a speed of 15 knots. Propulsion will be by a Holmes-Werkspoor diesel engine of 1600 b.h.p.

JOHN DRYSDALE AND CO., Ltd., has been awarded a contract for road improvement on the Gretna-Stranraer-Glasgow-Stirling trunk road (A.77) between Malletsheugh Inn and Woodvale Avenue. The site of the improvement is at Newton Mearns in Renfrewshire and the work involves the widening and reconstruction of 3 miles of trunk road to provide dual carriageways and two 8ft wide footpaths. The work will be supervised, on behalf of the Secretary of State for Scotland, by Messrs. Kyle and Frew, consulting engineers. The scheme is estimated to cost £550,000 and will be completed in about two years.

HENRY BALFOUR AND CO., Ltd., has received orders from the East Midlands Gas Board and the South Western Gas Board for plant involving the recently developed Frodingham desulphurising process. At Basford Gasworks, Nottingham, a unit of 5,000,000 cubic feet capacity a day is to be installed for the simultaneous removal of H_2S and organic sulphur. This is in the nature of a semi-experimental plant and is not, as yet, provided with facilities for the recovery of the sulphur as sulphuric acid. At Exeter Gasworks a complete plant with a capacity of about 8,000,000 cubic feet of gas a day is to be installed, together with a sulphuric acid plant of the dry contact type which is being supplied by the Power Gas Corporation. This Exeter plant is designed for 99 per cent removal of H_2S with the simultaneous removal of organic sulphur compounds to the extent of 90 per cent, with the exception of thiophen, which is expected to be reduced by about 20 per cent.

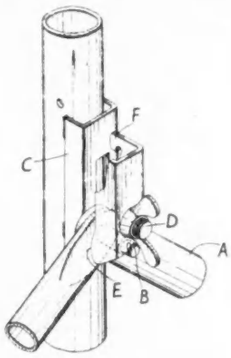
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

BUILDING EQUIPMENT

820,806. May 10, 1957.—CLAMPING CONNECTIONS FOR FRAMEWORK, Acrow (Engineers), Ltd., 8, South Wharf, Paddington, London, W.2. (*Inventor: Eric George Benjamin Crook.*)

In accordance with this invention, a tubular scaffold member is provided with means for securing bracing members to it, and an example is shown in the accompanying drawing. The scaffold tubular



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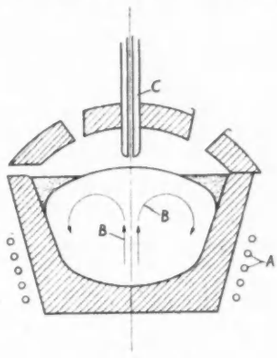
upright has securing means for bracing members *A* comprising a pin *B* fixed to a channel *C* welded to the tube. A movable pin *D* carrying a channel cover plate is engaged in a longitudinal slot in the channel *C* and this cover plate can be set in a position in which it at least partially covers the ends of the bracing members on the pin. The bracing members are then squeezed between the channel *C* and the cover plate when a nut on the outer end of the pin *D* is tightened. The side flanges of the cover plate terminate in toes *E* for bearing on the bracing members in this position whilst a notch enables the plate to be properly located against the fixed pin. A hook notch *F* on each side flange of the cover plate enables it to be temporarily suspended in a position in which, with the movable pin *D* still engaged in the slot, it is well clear of the fixed pin *B* for the bracing members to be readily engaged on the pin.—*September* 30, 1959.

METALLURGY

821,033. March 4, 1957.—CONVERSION OF MOLTEN PIG IRON TO STEEL, Metallurgical Oxygen Processes, Ltd., and Alfred Gordon Evans Robiette, both of 76, Cannon Street, London, E.C.4.

According to the present invention there is provided a process of converting a bath of molten pig iron to steel in which oxygen or oxygen enriched air is projected under low pressure on to the surface of the bath, characterised in that the molten pig iron is stirred by electromagnetic forces in such a way that the portion of the bath surface on to which the gas is projected is continuously cleared of slag while the slag is simultaneously being collected about the outer surface of the bath. The slag is continuously removed from the bath, thereby ensuring that the oxidising gas reacts with the molten pig iron. One way of carrying out the invention is illustrated in the drawing, which shows a vertical section through a furnace. The body or hearth of the furnace is of bowl shape and having outside the refractory wall a normal or low-frequency inductor coil *A* of helical shape. This coil is so arranged that when energised with mains frequency current, e.g. at a frequency of 50 c/s to 60 c/s, the metal is circulated in the direction indicated by the arrows *B*. The circulation is normally sufficiently rapid to produce a pronounced convex meniscus or crown at the top surface of the metal, which tends to assume a spherical shape. Because of the direction of movement, and the shape of the surface, the slag formed is driven to the sides of the bath, leaving the crown relatively clean. An oxidising gas is therefore blown on to this clean surface through a water-cooled tube *C*. The bath can be closed by a roof formed with an outlet for the gaseous products of the reaction, and one or more openings for making additions such as alloys or fluxes required in the refining process. Suitable slag-tapping notches are provided below the level of the portion of the bath surface on to which the gas is projected to enable continuous removal of the slag from the bath during conversion. The



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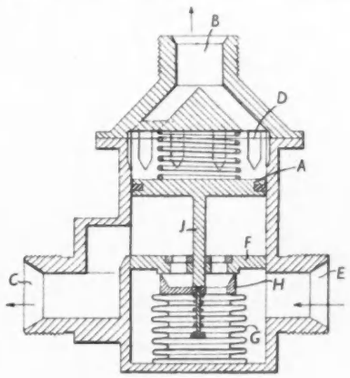
degree of stirring can be varied by varying the power input of the electric supply or its frequency, or by varying the position of the coil relative to the bath. Normally, however, the coil would impart little heat to the bath, most of the energy being used for circulation purposes. The speed of reaction can be controlled by adjusting the rate of circulation and the rate of oxygen supply, or both. The temperature of the reaction may be controlled by the addition of scrap or iron ore.—*September* 30, 1959.

MISCELLANEOUS

821,053. February 7, 1957.—FLUID PRESSURE-REDUCING MECHANISM, Dunlop Rubber Company, Ltd., 1, Albany Street, London, N.W.1. (*Inventor: Douglas Dewar.*)

One embodiment of the invention is described with reference to the accompanying drawing. The mechanism comprises a housing with a bore in which a piston *A* is slidable. The upper side of the piston forms a wall of an exhaust chamber connected to atmosphere through a vent *B*, and a spring urges the piston away from the vent. The other side of the piston forms a wall of an operating chamber connected to the mechanism to be operated through an outlet connection *C*. The end of the bore adjacent the vent *B* has a number of spaced axial recesses *D*, the arrangement being such that a predetermined movement of the piston against the spring uncovers the recesses and allows pneumatic pressure from the operating chamber to flow past the piston to the exhaust chamber and thence to atmosphere. As the piston moves up towards the outlet the size of the exhaust chamber becomes progressively less. The lower end of the housing comprises a pressure chamber which is adapted to be connected to a source of pneumatic pressure through the connection *E*. A wall *F* separating the pressure and the operating chambers has passages arranged symmetrically about the axis of the bore. A metal bellows *G* has one end secured to the pressure chamber wall directly opposite the passages, and an annular valve-member *H* secured to the other end prevents the flow of air from the pressure chamber to the operating chamber. The outside diameter of the valve is equal to the effective diameter of the bellows and the arrangement of parts is such that, with the valve closed, the pressure inside the pressure chamber cannot act to lift the valve off its



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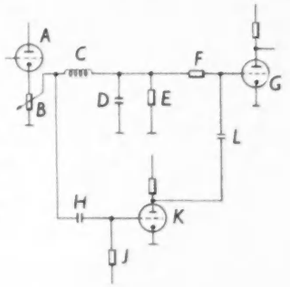
seating. The piston is connected to the valve by a lost motion device comprising a rod *J* which extends through the operating chamber and a guide in the wall *F*. The central portion of the valve *H* is abutted by the end of the piston rod and has a number of passages through it. A stem at the end of the piston rod, free to slide through the valve, terminates in an abutment and a light spring is fitted in between the abutment and the valve. In the inoperative position of the mechanism, the piston is forced by its return spring and towards the valve *H*, until the abutment on the end of the stem of the rod *J* contacts the wall of the housing within the bellows. The piston rod carries the valve *H* with it to an open position. Air under pressure enters the lower chamber and passes through the open valve *H* to the operating chamber above and thence to the mechanism to be operated. This pressure acts on the piston *A* and as the pressure in the mechanism and in the operating chamber increases, the piston is forced down the bore against its compression spring. As the piston progressively moves back, the valve *H*, urged by its spring, follows it, until the valve is seated and the supply of pneumatic pressure from the source is cut off. The rating of the piston compression spring is arranged so that the predetermined cut-off pressure will have moved the piston a sufficient distance to close the valve. In this balanced condition the piston is situated adjacent the ends of the recesses *D* leading to exhaust. It frequently happens that, due to the effects of heat, atmospheric changes and the like, the pressure, in the operating chamber rises above the predetermined value, even though the valve is closed. In this invention means to prevent this from occurring are provided in that, if the pressure should increase, it forces the piston *H* further down the bore until the adjacent ends of the recesses *D* connecting the operating and exhaust chambers are uncovered. Compressed air flows to exhaust until the correct operating chamber pressure is reached, when the piston spring moves the piston back to close the recesses. During this phase of the operation the valve remains seated, the piston stem sliding through the hole. Only a small piston movement is required to connect the operating chamber with exhaust and the rate of the piston spring is so arranged that this movement takes place with only a very small increase in operating chamber pressure above the predetermined value. An advantage of the pressure-reducing mechanism described is that it can be used in conditions which prevent the use of rubber or similar seals.—*September* 30, 1959.

ELECTRONICS

821,119. May 24, 1957.—DIFFERENTIAL CORRECTION OF TELEVISION RECEIVERS, Standard Telephones and Cables, Ltd., Connaught House, 63, Aldwych, London, W.C.2.

It is well known that transmission links, such as cable sections, in a television system cause a limitation of the band-width of the signals transmitted. The present invention provides a circuit arrangement which results in an improved picture from a signal which has been limited in the manner described. Referring to the drawing, there is shown a circuit



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which includes a video amplifier valve *A*. Potentiometer *B* controls the amplitude of the output from the valve. The output signal is applied via a first path, which includes an inductor *C* and a capacitor *D*, across a resistor *E* and via a resistor *F* to the grid of a video output valve *G*; and a second path which includes a capacitor *H*, a resistor *J*, an amplifier valve *K*, and a capacitor *L* across resistor *E* and to the grid of video output valve *G*. A bias voltage applied via resistor *J* to the grid of valve *K* may be varied in order to vary the amplification of that valve. Inductor *C* and capacitor *D* form a delay network, and capacitor *L*, resistor *F*, and resistor *E*, form a differentiating network. The delay network and the differentiating network are so dimensioned that the signals from each when added together across resistor *E* produce a combined signal which is an improvement upon the original output signal from valve *A*.—*September* 30, 1959.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, Oct. 30.—COVENTRY AND DISTRICT BRANCH : Visit to Lockheeds, Ltd., Leamington Spa, 7.30 p.m. ★ STOKE AND CREWE BRANCH : Grand Hotel, Hanley, " Hospital Electrical Installations," G. Middlemas, 7.30 p.m.

Mon., Nov. 2.—BOLTON BRANCH : Railway Hotel, Trinity Street, Bolton, " Miniature Circuit Breakers," J. A. Robbins, 7.45 p.m. ★ ESSEX BRANCH : Angel Hotel, Ilford, " War-Time Evasion and Escape," E. H. Maddox, 8 p.m. ★ LEEDS BRANCH : Great Northern Hotel, Leeds, " Transformers," Mr. Stancliffe, 7.30 p.m. ★ SHEFFIELD BRANCH : Royal Victoria Hotel, Sheffield, Lecture by J. J. Moulson, 7.30 p.m.

Tues., Nov. 3.—ALDERSHOT AND DISTRICTS BRANCH : Station Hotel, Basingstoke, Hants, " Recent Developments in Discharge Lighting," G. V. McNeill, 7.30 p.m. ★ NEWCASTLE UPON TYNE AND DISTRICT BRANCH : Crown Hotel, Clayton Street, Newcastle upon Tyne, " Switchgear Protection," 7.30 p.m. ★ READING AND DISTRICTS BRANCH : College of Further Education, Bourne Road, Maidenhead, Berks, " Protective Equipment for Industrial Plant," W. L. Stern, 7.30 p.m. ★ WEST LONDON BRANCH : Windsor Castle Hotel, 134, King Street, Hammersmith, W.6, Colour film of the 1959 Electrical Engineers (A.S.E.E.) Exhibition, 7.30 p.m.

Wed., Nov. 4.—HALIFAX BRANCH : Crown Hotel, Horton Street, Halifax, " Control Centres," R. G. Camp, 7.45 p.m. ★ MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, 2, " Maintenance of Electrical Switchgear," F. G. Thompson, 7.15 p.m. ★ NORTH LONDON BRANCH : Wood Green Civic Centre, Town Hall, Wood Green, N.22, " Floor Warming," C. J. Wheeler, 8 p.m.

Fri., Nov. 6.—LIVERPOOL AND DISTRICT BRANCH : Industrial Development Centre, M.A.N.W.E.B., Paradise Street, Liverpool, Discussion on " Education and Training for the Electrical Industry," 7.30 p.m.

BRITISH ELECTRICAL AND ALLIED MANUFACTURERS ASSOCIATION

Tues. and Wed., Nov. 3 *and* 4.—Connaught Rooms, Kingsway, London, W.C.2, 4th Annual Publicity Conference, 9.45 a.m. to 5 p.m. (*Nov.* 3) ; 9.15 a.m. to 12.45 p.m. (*Nov.* 4).

BRITISH INSTITUTE OF MANAGEMENT

To-day, Oct. 30.—FIFTH ELBOURNE MEMORIAL LECTURE : Assembly Hall, Royal Commonwealth Society, Northumberland Avenue, London, W.C.2, " The Management Burden," H. Wilmot, 8 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Mon., Nov. 2.—MERSEYSIDE SECTION : University Club, 2, Mount Pleasant, Liverpool, " Electronics in the Auto-Pilot of the ' Firestreak ' Missile," A. Bedford, 7 p.m.

Wed., Nov. 4.—COMPUTER GROUP : London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, Symposium on " Input/Output Devices," 3 p.m. and 6 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Tues. and Wed., Nov. 3 *and* 4.—Royal Hotel, Scarborough, Conference on " Fuel Economy through Automatic Operation."

ILLUMINATING ENGINEERING SOCIETY

Wed., Nov. 4.—EDINBURGH CENTRE : Y.M.C.A. Social Room, 14, South St. Andrew Street, Edinburgh, " The History of Lighting," S. S. Beggs, 6.15 p.m. ★ NEWCASTLE UPON TYNE CENTRE : Large Lecture Theatre, Dept. of Chemistry, Kings College, Newcastle upon Tyne, " Lighting and Safety in Building Operations and Works of Engineering Construction," J. Gordon-Scott, 6.15 p.m.

Thurs., Nov. 5.—GLASGOW CENTRE : British Lighting Council, 29, St. Vincent Place, Glasgow, C.1, " The History of Lighting," S. S. Beggs, 6.30 p.m.

INDUSTRIAL EFFICIENCY AND SAFETY EXHIBITION

Tues. to Sat., Nov. 3 *to* 14.—City Hall, Deansgate, Manchester, *Nov.* 4.—" Mechanisation and Automation," J. Morgan, 11 a.m. *Nov.* 5.—" Fuel Conservation," D. P. Golch, 3 p.m., and *Nov.* 10.—" Impact of Change on Management." Dr. Roberts, 11 a.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Nov. 2.—STUDENT MEETING : Memorial Building, 76, Mark Lane, London, E.C.3, Discussion on " The Day to Day Management of a Ship and Its Machinery," 6.30 p.m. ★ MERSEYSIDE AND NORTH WESTERN SECTION : Liverpool Engineering Society, The Temple, Dale Street, Liverpool, " Nuclear Propulsion of Ships." R. P. Kinsey, 6 p.m. ★ JUNIOR LECTURE : Technical College, Falmouth, " Construction of the Ship," G. Ridley Watson, 7 p.m.

Tues., Nov. 3.—JUNIOR LECTURE : Willesden Technical College, London, N.W.10, " Modern Marine Water-Tube Boilers," A. P. Monk, 6 p.m.

Thurs., Nov. 5.—NORTH EAST COAST SECTION : Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne, " Refrigerating Machinery and Its Application in Ships," M. B. F. Ranken, 6.15 p.m.

INSTITUTE OF PETROLEUM

Wed., Nov. 4.—61, New Cavendish Street, London, W.1, " Oil and Transport," W. S. Ault, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Mon., Nov. 2.—EAST REGIONAL CENTRE : Council Chamber, Houldsworth Hall, 90, Deansgate, Manchester, " Driving Technique," 7.30 p.m. ★ SCOTTISH CENTRE : Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, " Chassis and Engine Manufacture," R. P. Chilton, 7.30 p.m.

Tues., Nov. 3.—EASTERN CENTRE : The Golden Hind Hotel, Cambridge, " Road Surfaces," G. Grime, 7 p.m.

Mon., Nov. 9.—WEST REGIONAL CENTRE : Liverpool Architectural Society's Rooms, Bluecoat Chambers, School Lane, Liverpool, 1, " Air Suspension," V. E. Gough, 7.30 p.m.

INSTITUTE OF WELDING

Tues., Nov. 3.—54, Princes Gate, Exhibition Road, London, S.W.7, Presidential Address, " Education in Welding," E. Seymour-Semper, 6 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Nov. 3.—Great George Street, Westminster, London, S.W.1, Presidential Address, A. C. Hartley, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

To-day, Oct. 30.—NORTH SCOTLAND SUB-CENTRE : Robert Gordon's Technical College, Aberdeen, Chairman's Address, A. J. O. Cruickshank, 7.30 p.m. ★ NORTH STAFFORDSHIRE SUB-CENTRE : Technical College, Stoke-on-Trent, " The Design and Performance of the Gas-Filled Cable System," E. P. G. Thornton and D. H. Booth, 7 p.m.

Mon., Nov. 2.—ELECTRONICS AND COMMUNICATIONS SECTION : Savoy Place, London, W.C.2, " Some Comments on the Classification of Waveguide Modes," A. E. Karbowiak ; and " Some Comments on Quasi-Optical Methods t Millimetre Wavelengths," L. Lewin, 5.30 p.m. ★ NORTH-EASTERN MEASUREMENT AND ELECTRONICS GROUP : Rutherford College of Technology, Newcastle upon Tyne, 1, " The New Post Office 700-type Telephone," F. E. Williams and F. C. Carter ; " The Design of an Automatic Sensitivity Control for a New Subscriber's Telephone Set—The British Post Office 700-type Telephone," F. E. Williams and F. A. Wilson, 6.15 p.m. ★ SOUTH MIDLAND CENTRE : James Watt Memorial Institute, Birmingham, " The Electrification of the U.K.A.E.A. Industrial Group Factories," J. W. Binns and W. J. Outram, 6 p.m.

Tues., Nov. 3.—MEASUREMENT AND CONTROL SECTION : Savoy Place, London, W.C.2, " An Analogue Electronic Multiplier Using Transistors as Square-Wave Modulators," P. Gleghorn, 5.30 p.m. ★ EAST MIDLAND CENTRE : E.M.E.B. Service Centre, Derby, Joint Meeting with the Institution of Locomotive Engineers, " The Deltic Locomotive," C. M. Cock, 6.30 p.m. ★ CAMBRIDGE ELECTRONICS AND COMMUNICATIONS GROUP : Cavendish Laboratory, Free School Lane, Cambridge, Chairman's Address, " The Development of Eurovision," M. J. L. Pulling, 8 p.m. ★ NORTH MIDLAND CENTRE : Lecture Theatre, Electrical Dept., The University, Leeds, " The Application of Low-Pressure Resins to Some High-Voltage Switchgear Designs," T. R. Manley, K. Rothwell and W. Gray, 6.30 p.m. ★ NORTH-WESTERN CENTRE : Engineers' Club, 17, Albert Square, Manchester, " The Application of Irradiation in Industry," M. C. Crowley-Milling, 6.15 p.m. ★ SOUTH-EAST SCOTLAND SUB-CENTRE : Carlton Hotel, North Bridge, Edinburgh, " Silicone Electrical Insulation " J. H. Davis 7 p.m.

Wed. Nov. 4.—TEES-SIDE SUB-CENTRE : Cleveland Scientific and Technical Institution, Middlesbrough, " The Provision of Adequate Electrical Installations in Buildings " : (*a*) " Housing," C. C. Hyams, 3 p.m., and (*b*) " Commercial Buildings," E. E. Jacobi, 6.30 p.m. ★ SOUTH-WEST SCOTLAND SUB-CENTRE : Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, 50th Kelvin Lecture, " The Geophysical Year 1957–58," Sir David Brunt, 6 p.m. ★ SOUTHERN CENTRE : The University, Southampton, " Review of E.H.T. Air-Blast Switchgear," G. K. Simpson, 7 p.m.

Thurs., Nov. 5.—ORDINARY MEETING : Savoy Place, London, W.C.2, " The Application of Irradiation in Industry," M. C. Crowley-Milling, 5.30 p.m.

Fri., Nov. 6.—MERSEY AND N. WALES CENTRE : Talbot Hotel, Wrexham, " Discrimination Between H.R.C. Fuses," E. Jacks, 7 p.m.

Mon., Nov. 9.—ELECTRONICS AND COMMUNICATIONS SECTION : Savoy Place, London, W.C.2, " Theory of the Travelling-Wave Parametric Amplifier," A. L. Cullen ; " The Gain of Travelling-Wave Ferromagnetic Amplifiers," P. J. B. Clarricoats ; " Some Properties of Travelling-Wave Resonance." J. R. G. Twisleton ; and " Saturation Effects in a Travelling-Wave Parametric Amplifier," A. Jurkus, 5.30 p.m. ★ EAST ANGLIAN SUB-CENTRE : Electric House, Ipswich, " The Influence of Consumers' Load/Consumption Characteristics on Metering Practice," L. B. S. Golds, 6.30 p.m. ★ MERSEY AND N. WALES CENTRE : Bluecoat Chambers, School Lane, Liverpool, " The Provision of Adequate Electrical Installations in Buildings," : (*a*) " Multi-Storey Flats and Maisonettes," C. A. Belcher ; (*b*) " Houses," C. Hyams ; (*c*) " Commercial Buildings," E. E. Jacobi, and (*d*) " Small Industrial Premises." J. A. Sharp, 6 p.m. ★ NORTH-EASTERN CENTRE : Neville Hall, Westgate Road, Newcastle upon Tyne, " Electrical Supplies to Power Station Auxiliaries," D. A. Dewison, 6.15 p.m. ★ SOUTH MIDLAND SUPPLY AND UTILISATION GROUP : College of Technology, Gosta Green, Birmingham, " Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott, 6 p.m. ★ WESTERN CENTRE : Electricity House, Bristol, " Subscriber Trunk Dialling," D. A. Barron, 6 p.m. ★ WESTERN UTILIZATION GROUP : Technical College, Bath, " The Deltic Locomotive," C. M. Cock, 6 p.m.

INSTITUTION OF ENGINEERING DESIGNERS

Wed., Nov. 4.—Queens Hotel, Birmingham, Films on " Lubrication," 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Nov. 3.—39, Elmbank Crescent, Glasgow, " Research on Steel and Aluminium Hatchway Beams," M. N. Parker, K. V. Taylor and J. A. Ross, 6.30 p.m.

INSTITUTION OF HIGHWAY ENGINEERS

Wed., Nov. 4.—EAST ANGLIAN BRANCH : Assembly House, Theatre Street, Norwich, " Formwork Design and Construction for Concrete " J. G. Richardson 6.45 p.m.

Fri., Nov. 6.—LONDON BRANCH : Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1, " Some Aspects of the Design of Road Improvements in an Urban Area," S. E. French, 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Oct. 30.—COVENTRY GRADUATES' SECTION : Visit to the works of Alvis, Ltd., Holyhead Road, Coventry, 7.30–9 p.m. ★ EAST MIDLANDS GRADUATES' SECTION : Visit to the Metal Box Company, Ltd., Addicroft Works, Sutton-in-Coldfield, Notts, 7 p.m.

Sat., Oct. 31.—WESTERN BRANCH : Visit to the Severn Pumping Station of British Railways, 2 p.m.

Mon., Nov. 2.—NORTH EASTERN BRANCH : Institute of Mining and Mechanical Engineers, Neville Hall, Newcastle, 1, Joint Meeting with the local branch of the Institution of Production Engineers, " Production, Fabrication, Properties and Uses of Some of the Newer Metals," N. P. Inglis, 6 p.m.

Tues., Nov. 3.—INTERNAL COMBUSTION ENGINE GROUP : 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on " Engine Installation Problems," 6 p.m. ★ EASTERN BRANCH : Good Companions Hotel, Stoke Poges Lane, Slough, " The Training of Soviet Engineers," E. G. Sterland, 7.30 p.m. ★ NORTH-EASTERN BRANCH : Cleveland Scientific Institute, Corporation Road, Middlesbrough, Joint Meeting with the North-Eastern Automobile Division Centre, " Inspection of Vehicles for Road Worthiness," R. D. Lister, 6.15 p.m. ★ LONDON GRADUATES' SECTION : 1, Birdcage Walk, Westminster, London, S.W.1, Mr. B. G. Robbins will speak on the functions of the Institution and on his 1958 world tour, 5.30 p.m.

Wed., Nov. 4.—ORDINARY MEETING : 1, Birdcage Walk, Westminster, London, S.W.1, " Design and Testing of Large Gas Ducts," A. T. Bowden and J. C. Drumm, 6 p.m. ★ EAST MIDLANDS BRANCH : Technical College, Lincoln, " Modern Foundry for the Manufacture of Small Steel Castings by New Moulding Techniques," C. B. Carter, 7.15 p.m. ★ SCOTTISH BRANCH : Dick Institute, Kilmarnock, Repetition of the James Clayton Lecture, " The Hydraulic Turbine in Evolution," P. Danel, 7.30 p.m. ★ YORKSHIRE BRANCH : George Hotel, Huddersfield, " Advanced Developments in the Design of Diesel Engines," R. J. Dain, 7.15 p.m. ★ EAST MIDLANDS GRADUATES' SECTION : College of Further Education, Loughborough, " Applications of Photoelasticity," T. McHowat, 7.15 p.m.

Thurs., Nov. 5.—SCOTTISH BRANCH : Royal College of Science and Technology, Glasgow, Repetition of the James Clayton Lecture, " The Hydraulic Turbine in Evolution," P. Danel, 7.30 p.m. ★ SOUTHERN BRANCH : C.E.G.B. Offices, Portsmouth, " Design and Construction of Power Station Feed Heaters," J. V. Bigg, 6.30 p.m. ★ SOUTHERN GRADUATES' SECTION : Technical College, Guildford, Film Show, 7 p.m.

Sat., Nov. 7.—SOUTHERN GRADUATES' SECTION : Visit to Hamworthy Engineering Company, Ltd., 2.30 p.m.

INSTITUTION OF PLANT ENGINEERS

Tues., Nov. 3.—GENERAL MEETING : Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2, " The Constructional Problems Encountered in the Kariba Dam Project," T. A. L. Paton, 7 p.m. ★ EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, " Water Treatment in Modern High Pressure Generating Stations," A. M. Lockhart, 7 p.m. ★ PETERBOROUGH BRANCH : White Lion Hotel, Church Street, Peterborough, " Colour Television," 7.30 p.m.

Wed., Nov. 4.—DUNDEE BRANCH : Taypark Hotel, West Ferry, Dundee, " Design and Operation of the Jodrell Bank Radio Telescope," C. N. Kington, 7.30 p.m. ★ SOUTHERN BRANCH : Royal Beach Hotel, Southsea, " Distribution of Electrical Power," J. Samson, 7.30 p.m.

Fri., Nov. 6.—WEST AND EAST YORKSHIRE BRANCH : Houldsworth School of Applied Science, The University, Leeds, " Design and Operation of the Jodrell Bank Radio Telescope," C. N. Kington, 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Mon., Nov. 2.—NORTHERN REGION : Institute of Mining and Mechanical Engineers, Neville Hall, Newcastle, 1, " The Production, Fabrication, Properties and Uses of Some of the Newer Metals." N. P. Inglis. 6 p.m.

Tues., Nov. 3.—NORTH MIDLANDS REGION : Loughborough College, Room A.1, Schofield Building, College of Technology, Loughborough, Illustrated Lecture, 7.30 p.m.

Wed., Nov. 4.—COVENTRY GRADUATE SECTION : Visit to Coventry Radiator and Presswork Company, Ltd., Canley Works, Coventry, and " A Modern Press Shop and Its Layout," 7.45 p.m. ★ NORTH MIDLANDS REGION : Reform Club, Victoria Street, Nottingham, " Adhesives in Engineering," E. J. Catchpole, 7 p.m.

Mon., Nov. 9.—EAST AND WEST RIDINGS REGION : Grand Hotel, Sheffield, " Pre-Stressed Rolling Mill," W. Udall, 6.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Tues., Nov. 3.—NORTHERN COUNTIES BRANCH : Cleveland Scientific and Technical Institution, Middlesbrough, " The Design and Construction of Shell-Roofed Buildings for Cadbury Bros., Ltd., at Moreton," J. E. C. Farebrother and L. E. May, 6.30 p.m. ★ NORTHERN IRELAND BRANCH : Civil Engineering Dept., Queen's University, Belfast, " Extensions to Constructional Shop : 170ft and Other Long Spans," F. R. Bullen, 6.30 p.m. ★ SCOTTISH BRANCH : Adelphi Hotel, Edinburgh, Joint Meeting with the East of Scotland Branch, Institute of Welding, " The 250ft Diameter Radio Telescope at Jodrell Bank " C. N. Kington, 6.15 p.m.

Wed., Nov. 4.—NORTHERN COUNTIES BRANCH : Neville Hall, Newcastle, " The Design and Construction of Shell-Roofed Buildings for Cadbury Bros., Ltd., at Moreton," J. E. C. Farebrother and L. E. May, 6.30 p.m. ★ WALES AND MONMOUTHSHIRE BRANCH : Mackworth Hotel, Swansea, Chairman's Address, " The Structural Aspect of Pipe Problems," C. D. C. Braine, 6.30 p.m.

Fri., Nov. 6.—MIDLAND COUNTIES BRANCH (GRADUATES AND STUDENTS' SECTION) : Birmingham Exchange and Engineering Centre, Birmingham, " Some Features of the Design, Construction and Operation of the 8ft by 8ft Supersonic Wind Tunnel at R.A.E. Bedford," T. Barnes and J. Y. G. Evans, 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 30.—Pepys House, 14, Rochester Row, Westminster, London, S.W.1, " Planning a Computer Job," M. G. Ferrand, 7 p.m.

Wed., Nov. 4.—MIDLAND SECTION : James Watt Memorial Institute, Great Charles Street, Birmingham. Debate, " It is the Opinion of this Meeting that Automation is Undesirable," 7 p.m.

Fri., Nov. 6.—Pepys House, 14, Rochester Row, London, S.W.1, Films, " Mirror in the Sky " ; " Ultrasonics," and " Conquest of the Atom," 7 p.m.

LIVERPOOL JOINT CHEMISTRY COMMITTEE

To-day, Oct. 30.—Lecture Theatre, The University, Vine Street, Liverpool, " Bulk Handling and Storage of Heavy Chemicals," W. A. S. White, 7.30 p.m.

LIVERPOOL METALLURGICAL SOCIETY

Thurs., Nov. 5.—Dept. of Metallurgy, The University, 146, Brownlow Hill, Liverpool, 3, " Ductile Fracture," R. W. K. Honeycombe, 7 p.m.

NEWCOMEN SOCIETY

Wed., Nov. 4.—Science Museum, South Kensington, London, S.W.7, " Joshua Gilpin, an American Manufacturer in England and Wales, 1795–1801," H. H. Hancock and W. B. Wilkinson, 5.30 p.m.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, Oct. 30.—Lecture Theatre, Literary and Philosophical Society, Newcastle upon Tyne, Opening General Meeting ; Film " The Dounreay Fast Reactors," 6.15 p.m.

Mon., Nov. 2.—ANDREW LAING LECTURE : Lecture Theatre, Literary and Philosophical Society, Newcastle upon Tyne, " Machinery for Large Tankers," G. B. Halley, 6.15 p.m.

PLASTICS INSTITUTE

Mon., Nov. 2.—MIDLANDS SECTION : James Watt Memorial Institute, Great Charles Street, Birmingham, 3, " High-Speed Injection Moulding and Latest Development in Injection Moulding Technique." E. Gasnar, 6.30 p.m.

Tues., Nov. 3.—Wellcome Building, 183–193, Euston Road, London, N.W.1, " Recent Advances in Synthetic Rubbers," W. F. Watson, 6.30 p.m.

REINFORCED CONCRETE ASSOCIATION

Tues., Nov. 3.—N. WESTERN BRANCH : College of Technology, Sackville Street, Manchester, " Reinforced Lightweight Concrete," A. Short, 6.45 p.m.

Wed., Nov. 4.—N. WESTERN BRANCH : Liverpool Engineering Society, The Temple, 24, Dale Street, Liverpool, Repetition of above lecture, 6.30 p.m.

ROYAL AERONAUTICAL SOCIETY

To-day, Oct. 30.—MAN-POWERED AIRCRAFT GROUP : The Library, 4, Hamilton Place, London, W.1, Inaugural Meeting, 7 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Thurs., Nov. 5.—CORROSION GROUP AND NOTTINGHAM SECTION : Demonstration Theatre, East Midlands Gas Board, 51–55, Lower Parliament Street, Nottingham, " Corrosion Factors Affecting the Choice of Stainless Steels for Chemical Plant," H. T. Shirley, 7.30 p.m.

SOCIETY OF ENGINEERS

Mon., Nov. 2.—Geological Society, Burlington House, Piccadilly, London, W.1, " The Dissemination of Technical Information with Particular Reference to the Aircraft Industry," K. A. Steel, 5 p.m.

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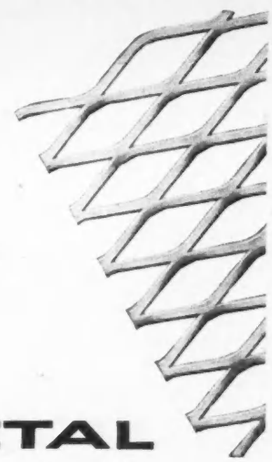

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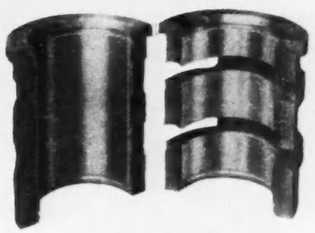

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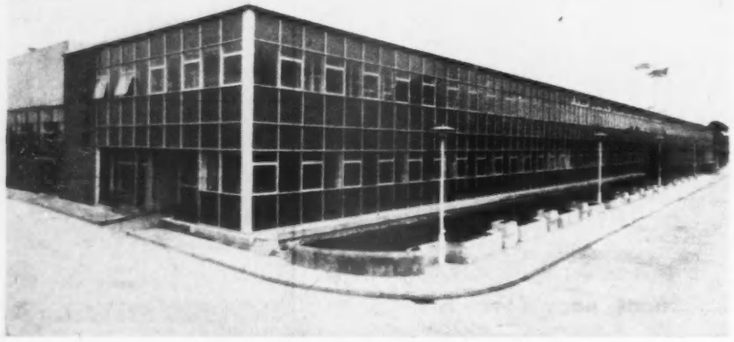

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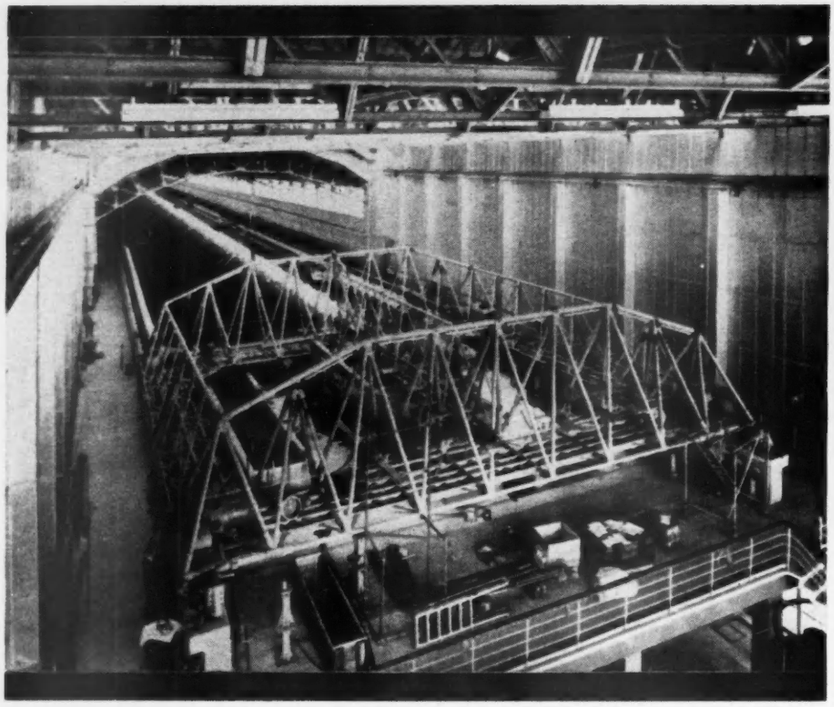

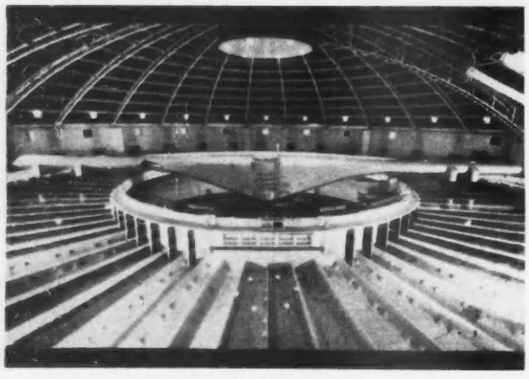

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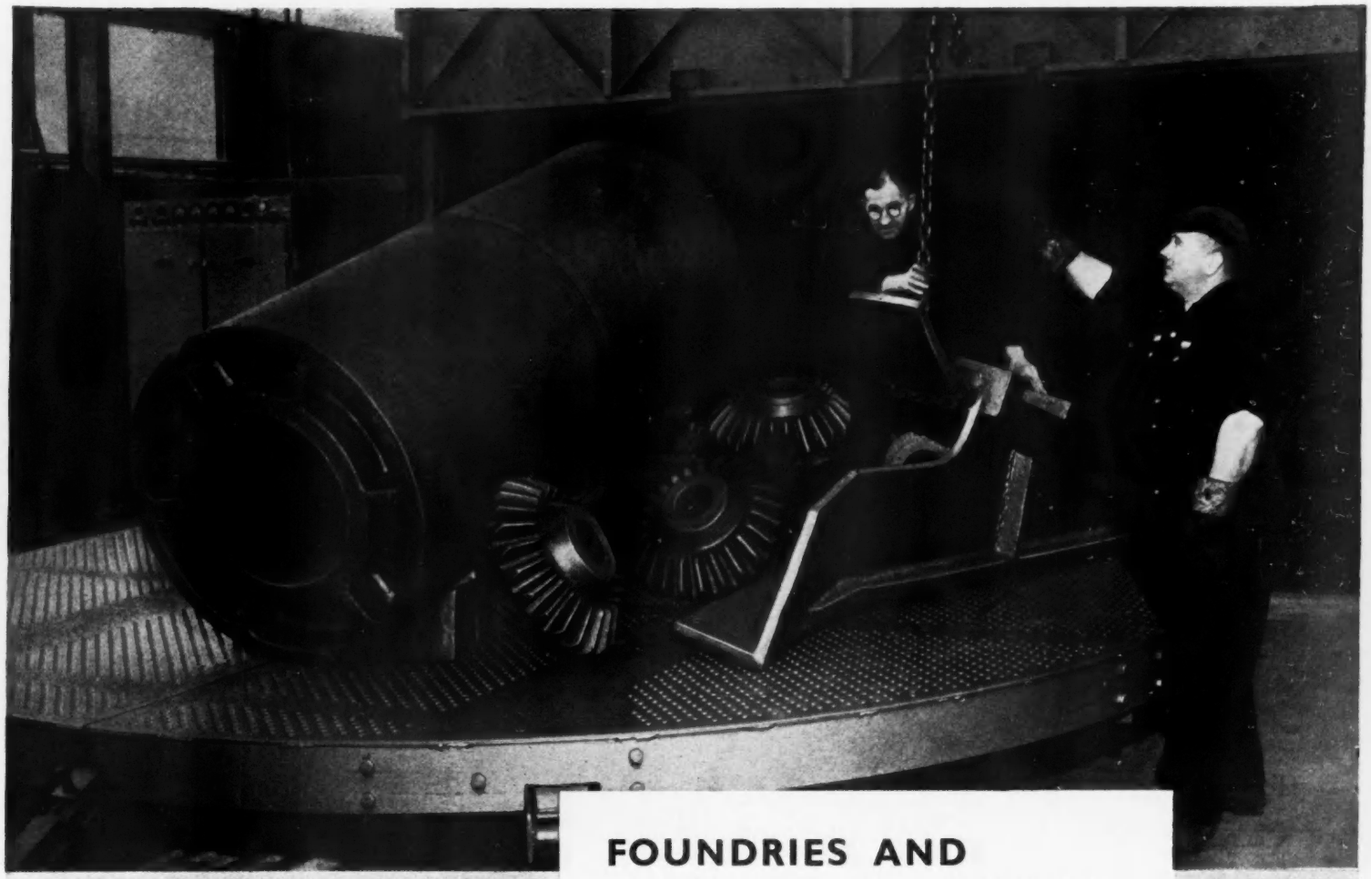

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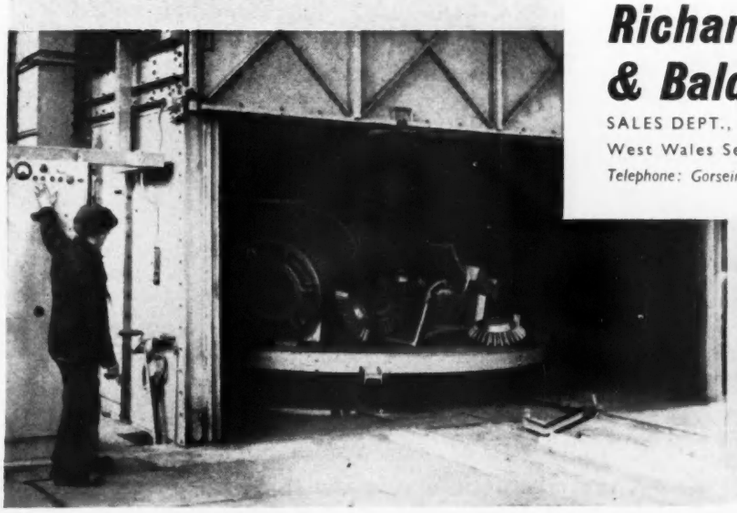

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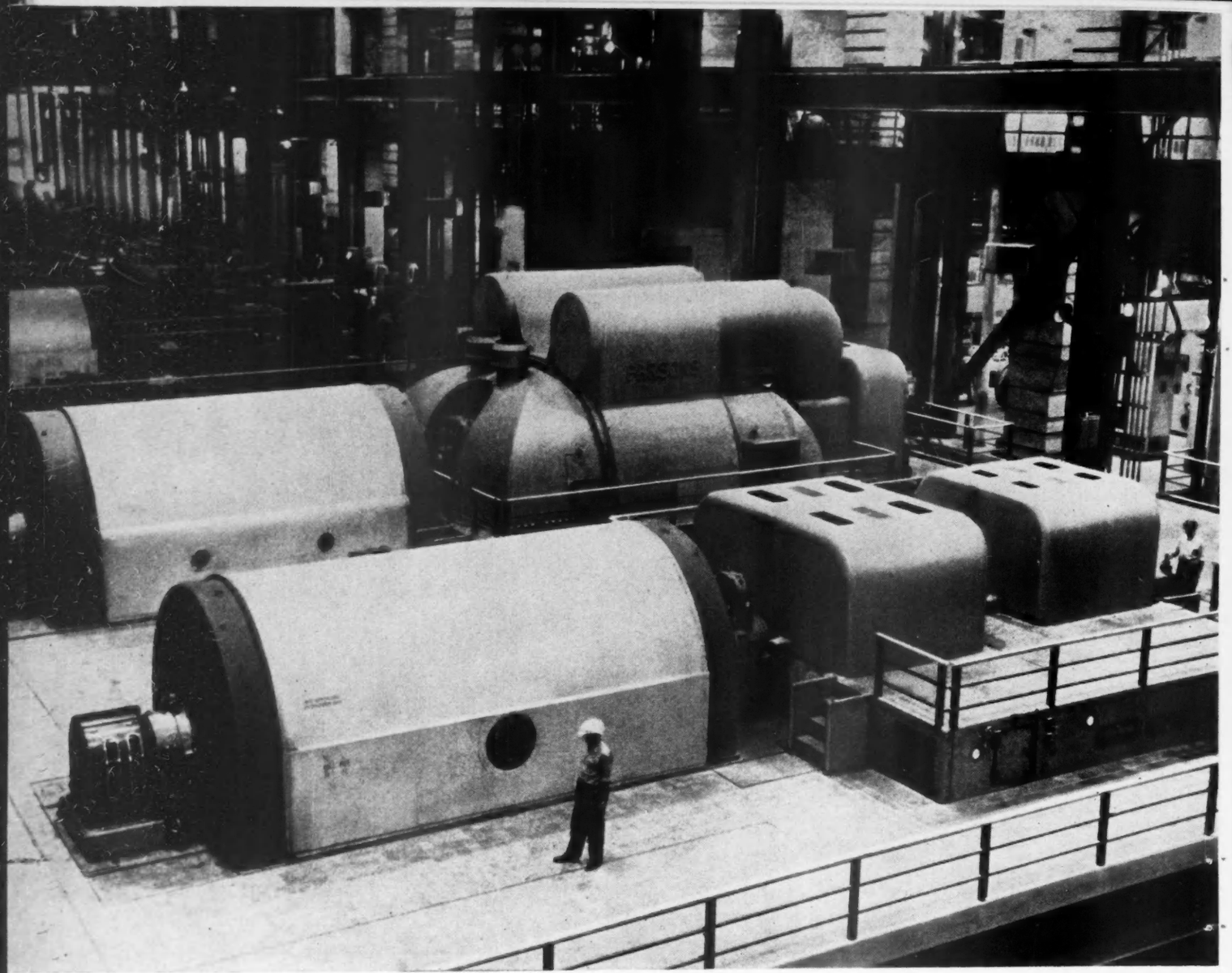

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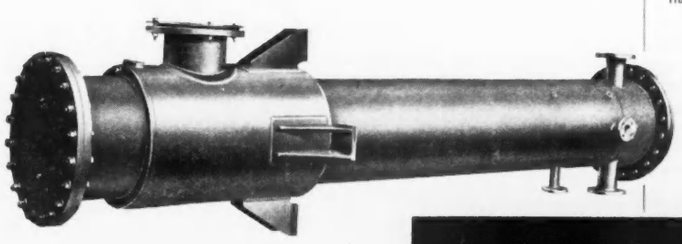

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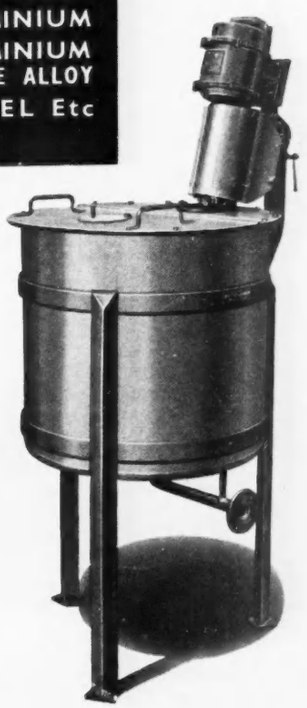

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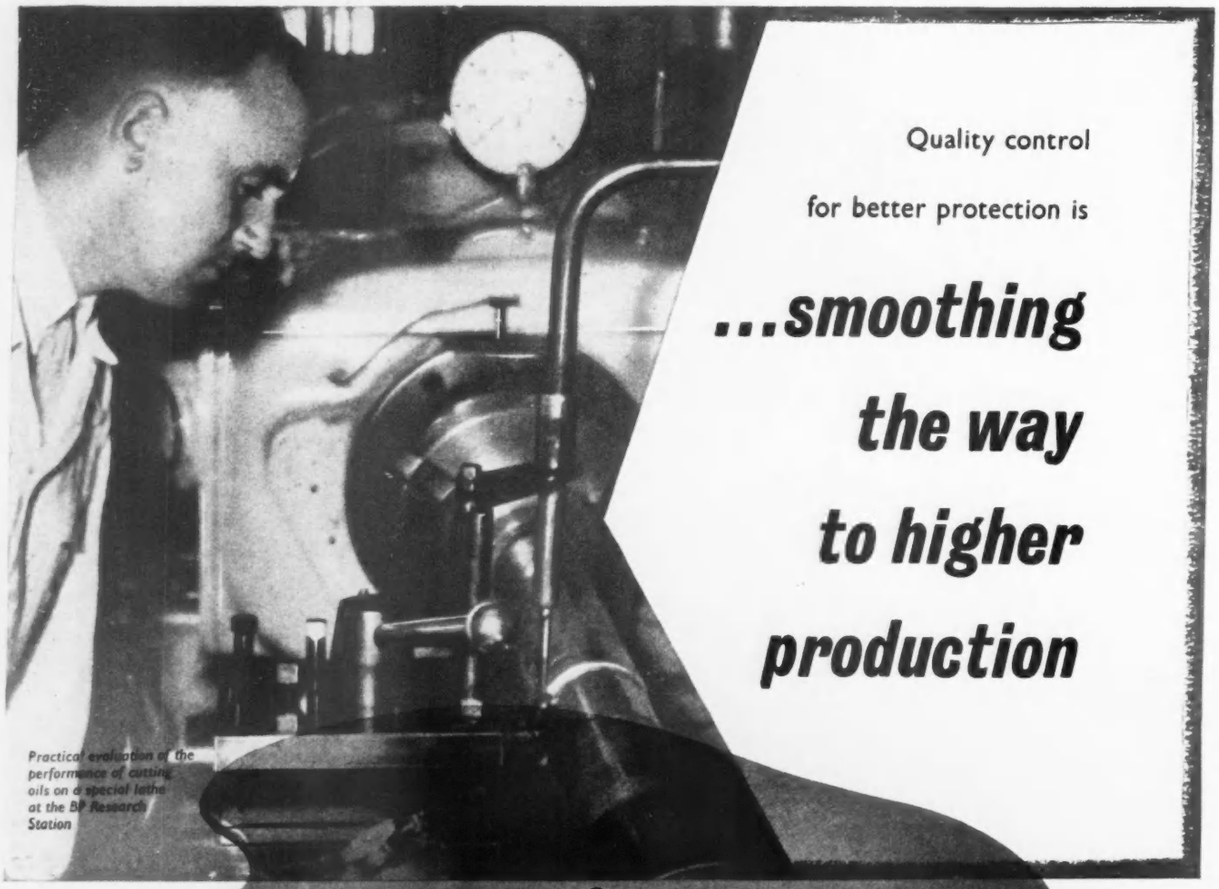
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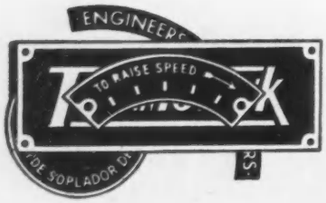

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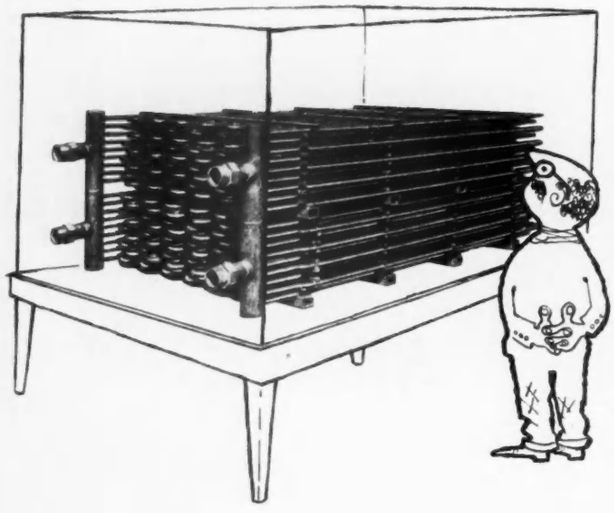

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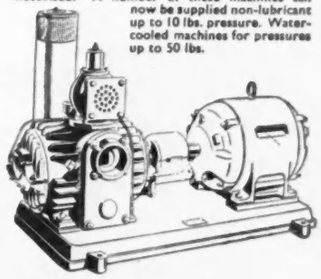

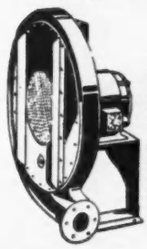

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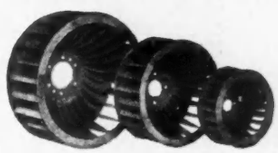

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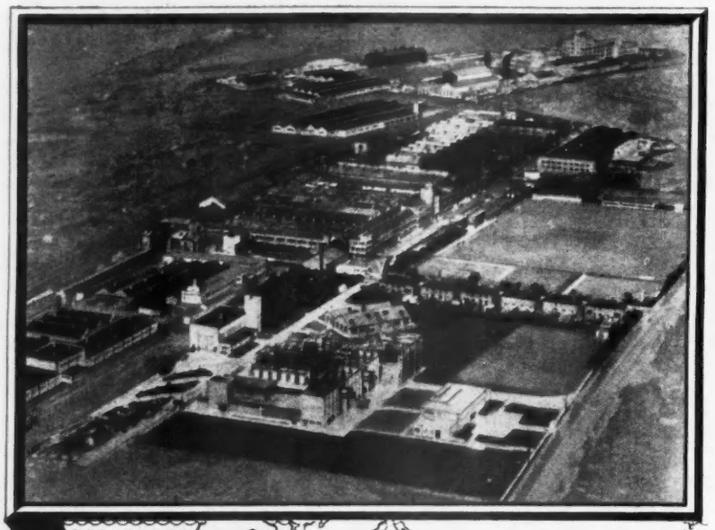

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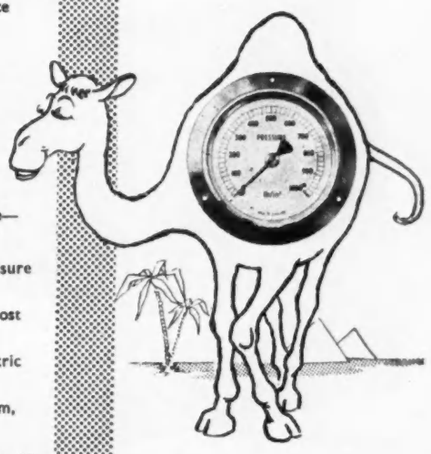

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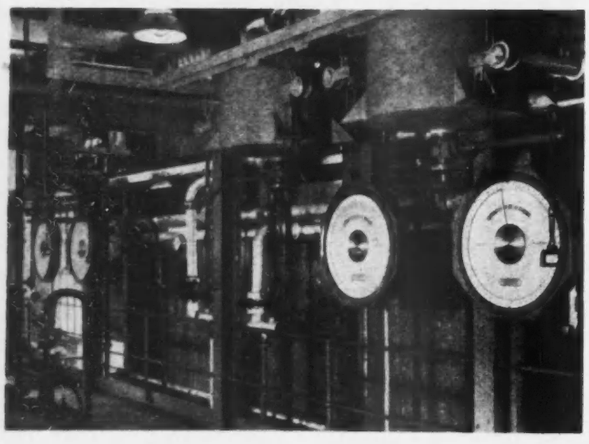

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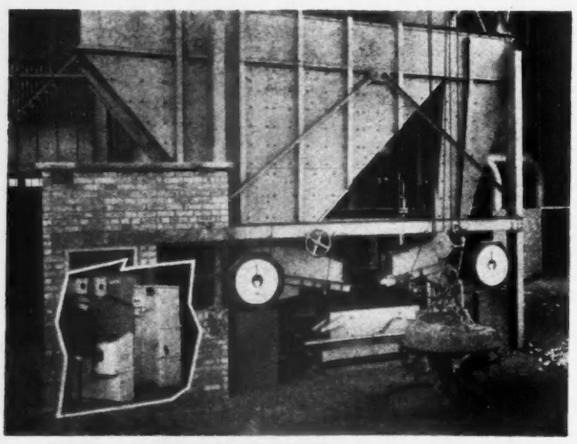

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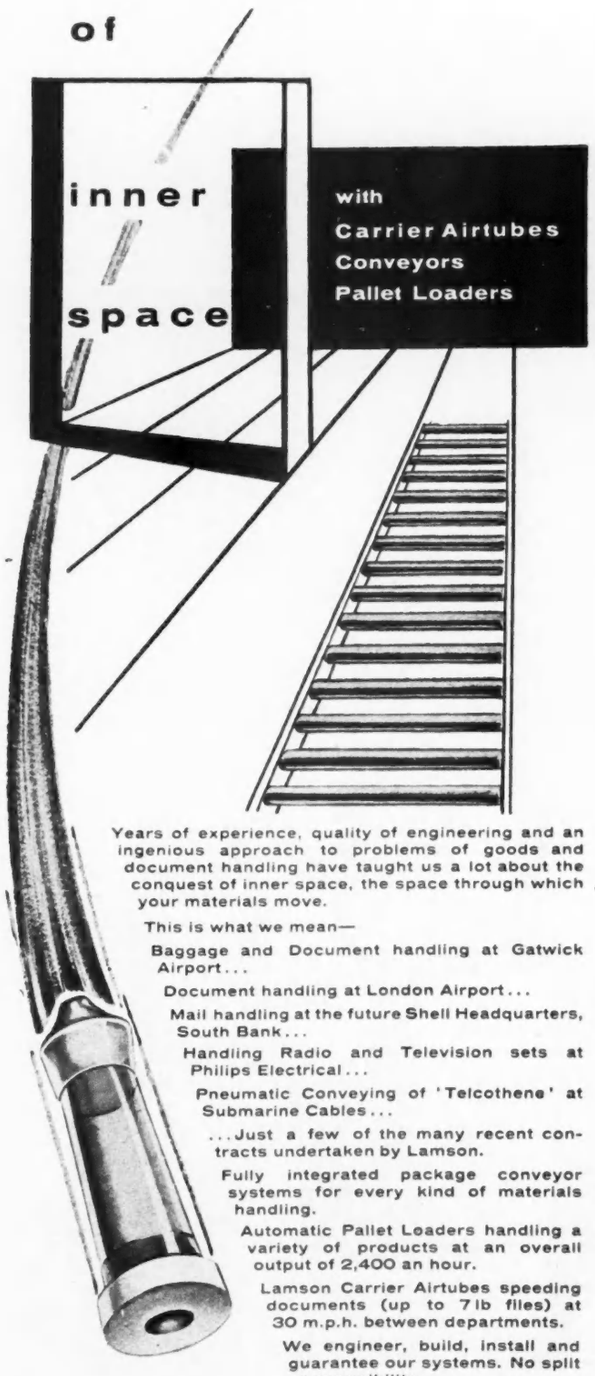

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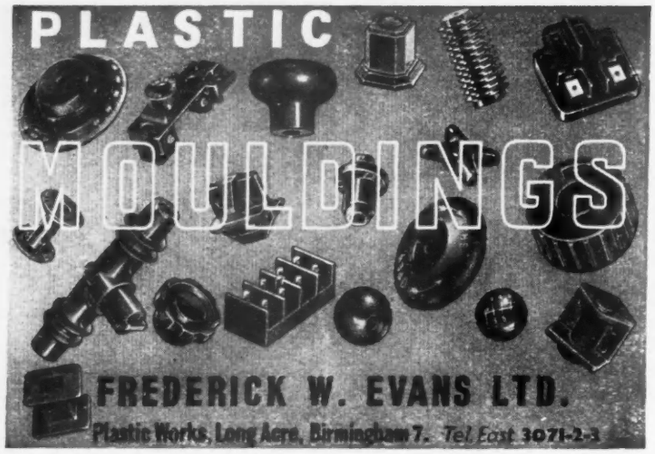

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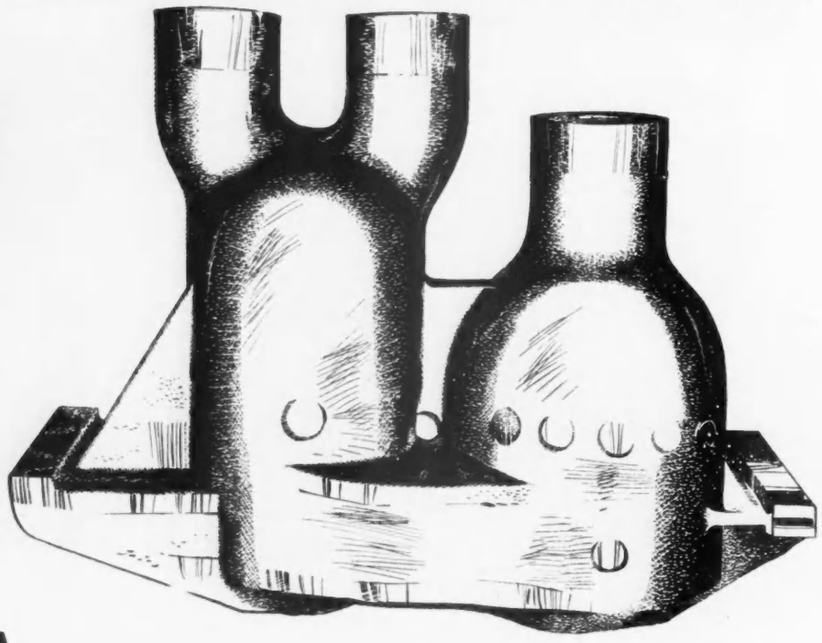

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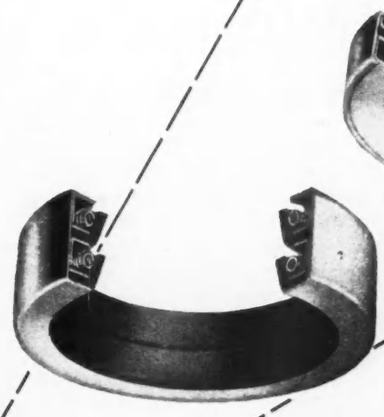

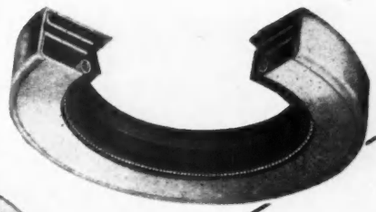

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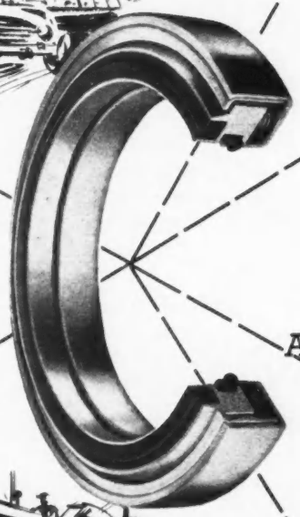

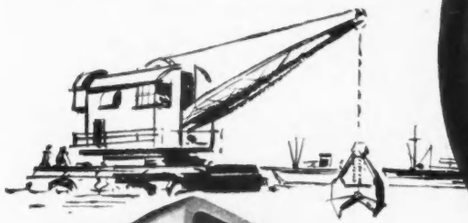

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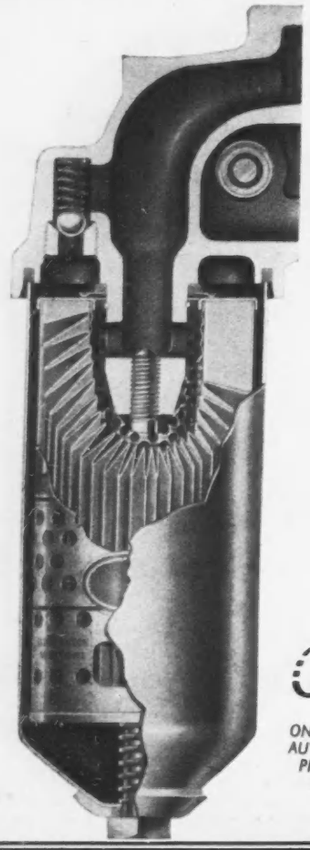

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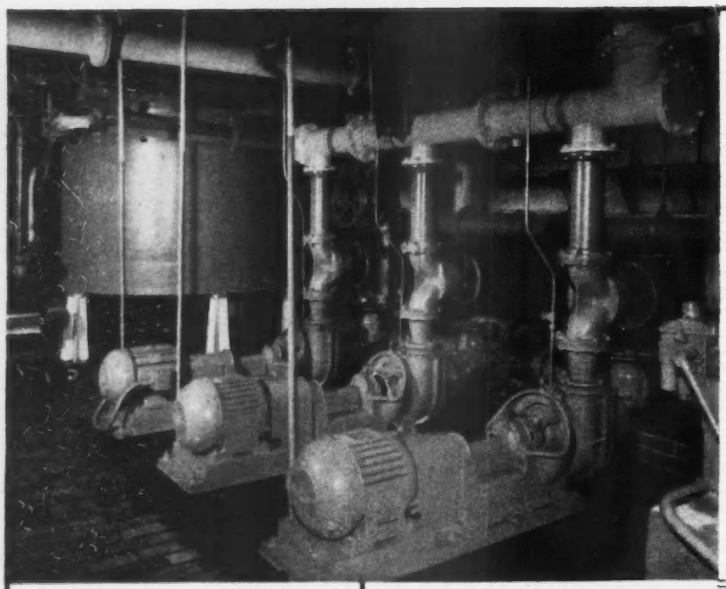

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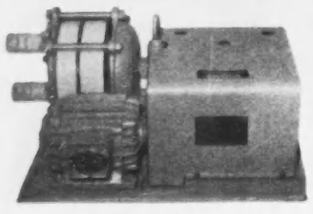
(Top left) Large battery centrifugal acid pumps
(Bottom left) Close-up view of diaphragm pump similar to the hand operated unit but arranged for motor drive
(Bottom centre) Hand operated portable diaphragm pump for emptying carboys or tanks and for general duties.
(Bottom right) Portable rotary displacement pump pumping plating solutions in the motor car trade



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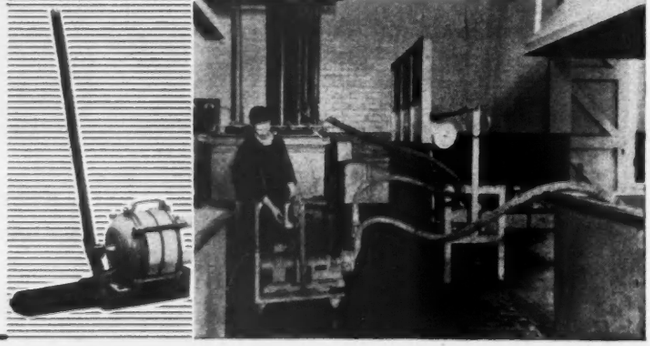

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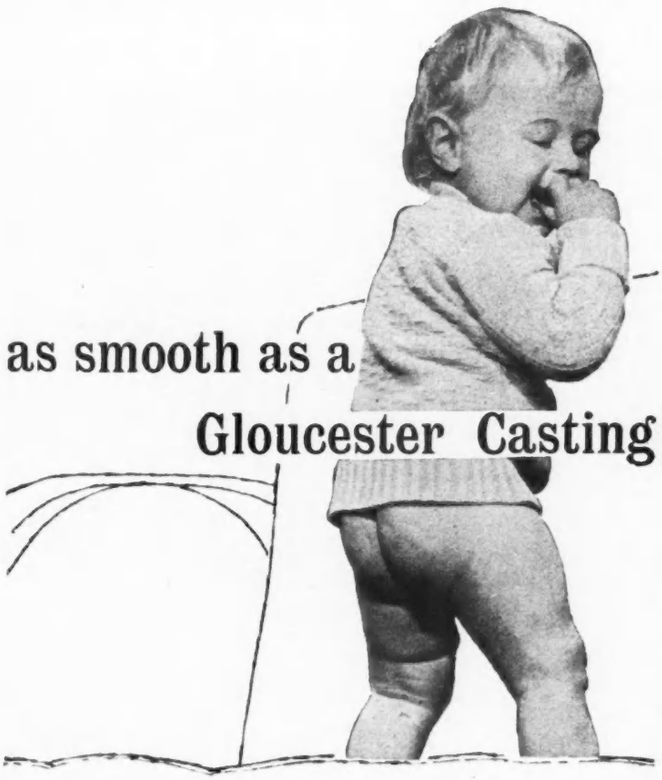

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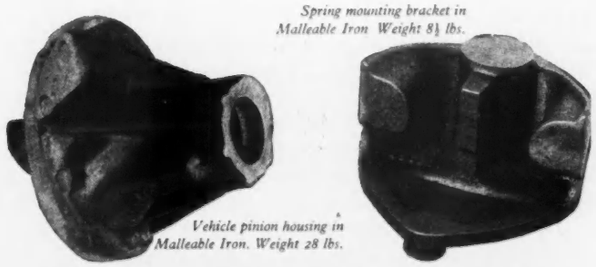
Tensile Strength 25 tons psi	Tensile Strength 35 tons psi

Spring mounting bracket in Malleable Iron Weight 8½ lbs.



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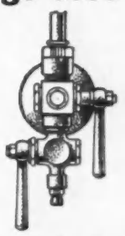

The gauge glass gave a seemingly safe water level, but overheating nevertheless exploded the boiler. Damage was extensive, production stopped, and the final bill—including loss of profits—was disastrous.

—and two people could have prevented the accident

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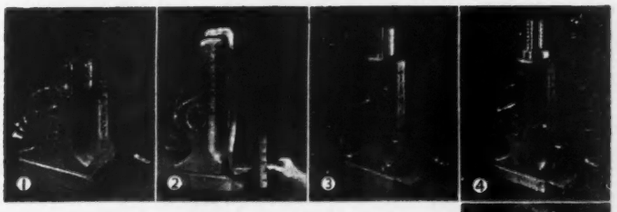

(1) A 6 ins./50 ton with plain ram. (2) Claw attach. on 12 ins./25 ton. (3) A 12 ins./25 ton with plain ram. (4) A 12 ins./25 ton with screwed ram. (5) A 6 ins./100 ton jack.

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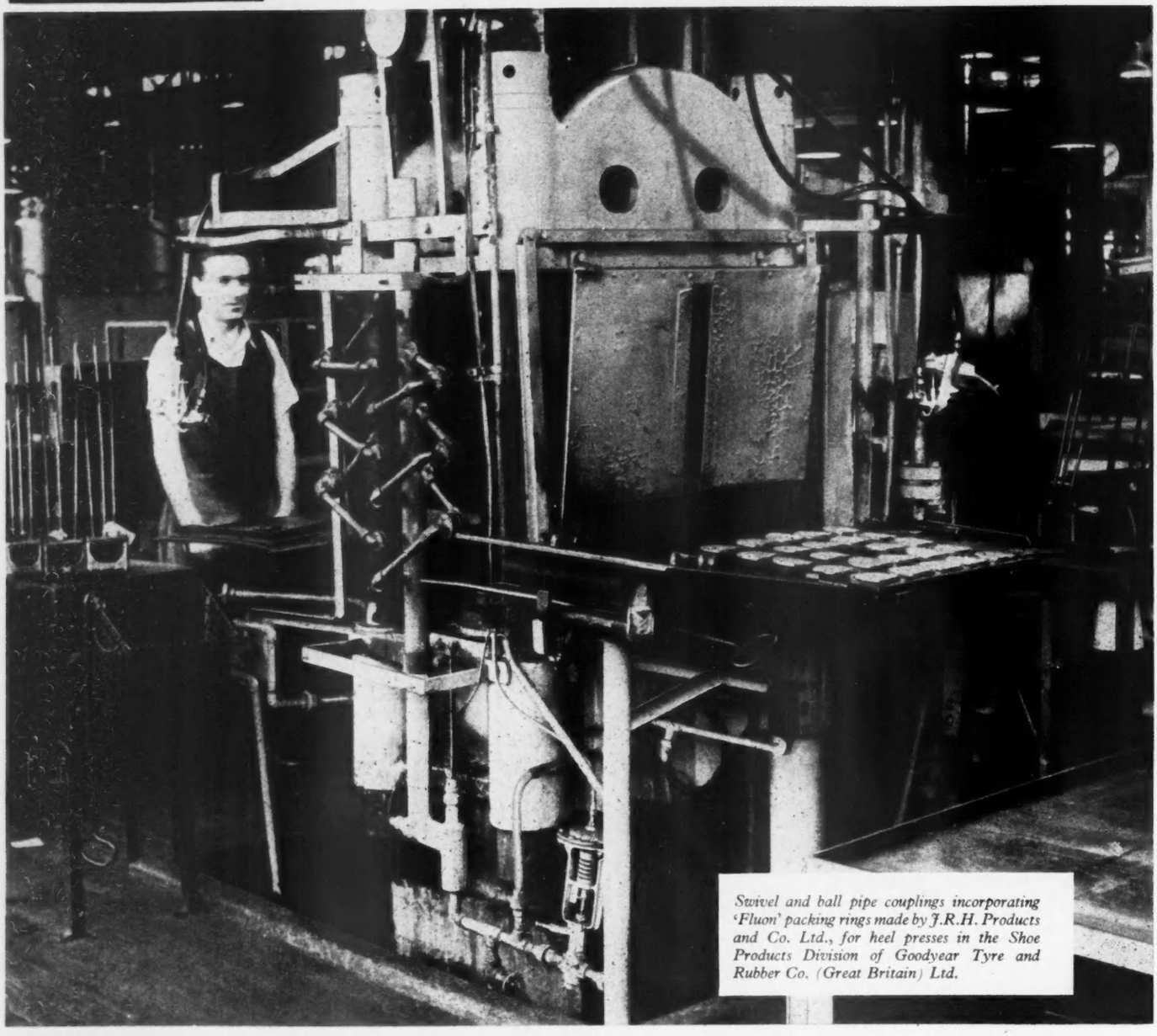
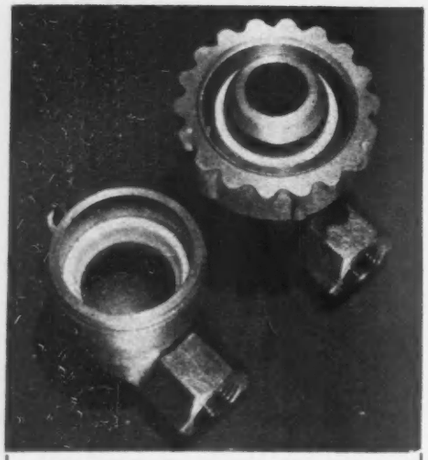


Swivel and ball pipe couplings incorporating 'Fluon' packing rings made by J.R.H. Products and Co. Ltd., for heel presses in the Shoe Products Division of Goodyear Tyre and Rubber Co. (Great Britain) Ltd.



Packing rings made from 'Fluon' in swivel and ball pipe coupling made by J.R.H. Products and Co. Ltd., Vale Road, Windsor.

'Fluon' packing rings used in swivel and ball pipe couplings on heel presses

HEEL PRESSES in the Shoe Products Division of Goodyear Tyre and Rubber Co. (Great Britain) Limited have swivel and ball pipe couplings which incorporate 'Fluon' p.t.f.e. packing rings. The couplings were made by J.R.H. Products and Co. Ltd., Vale Road, Windsor.

'Fluon' is an I.C.I. plastic material with a unique range of properties; properties which make it invaluable throughout industry today. 'Fluon' is immune to virtually all forms of chemical attack. Components made from 'Fluon' need no lubrication, because of its very low coefficients of friction, and resist degradation from ageing over an indefinite period. 'Fluon' is tough and flexible and has good impact strength. 'Fluon' has a remarkable working temperature range from +250°C. down to liquid nitrogen temperatures. Among other features of this exceptional plastic material are its very low permittivity and power factor, both of which are independent of frequency and temperature.

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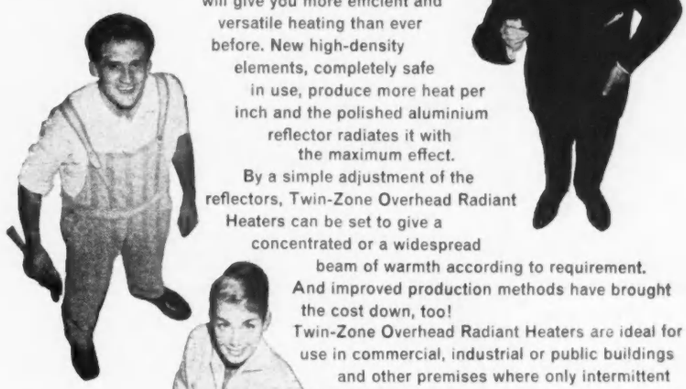
NEW! TWIN-ZONE overhead radiant heaters



Of entirely new and unique design, these Twin-Zone Overhead Radiant Heaters, in 1½ or 3 kW. loading, will give you more efficient and versatile heating than ever before. New high-density elements, completely safe in use, produce more heat per inch and the polished aluminium reflector radiates it with the maximum effect. By a simple adjustment of the reflectors, Twin-Zone Overhead Radiant Heaters can be set to give a concentrated or a widespread beam of warmth according to requirement. And improved production methods have brought the cost down, too!

Twin-Zone Overhead Radiant Heaters are ideal for use in commercial, industrial or public buildings and other premises where only intermittent heating is required or where the thermal insulation is too inefficient to justify overall air heating.
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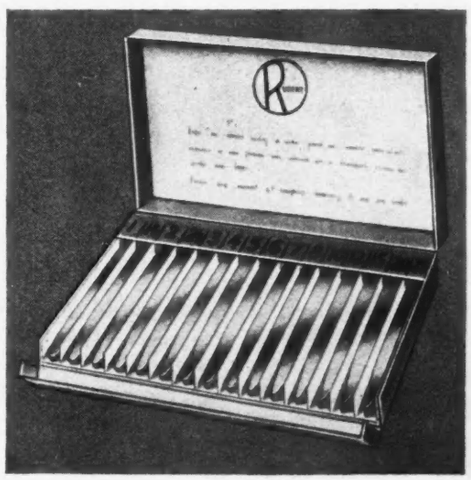

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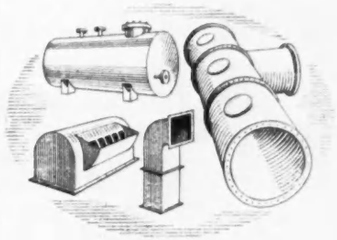

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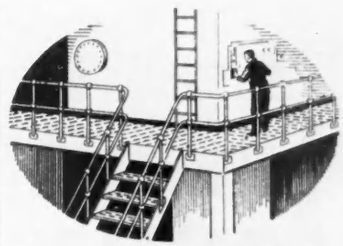

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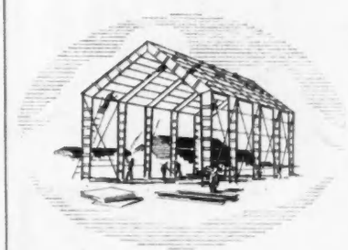

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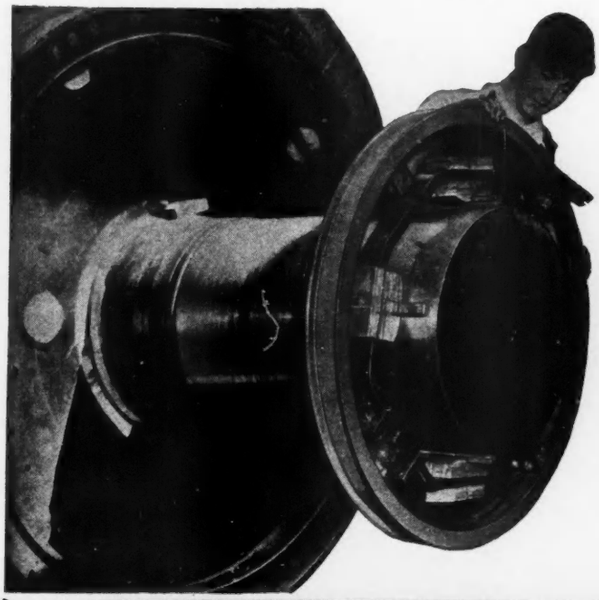

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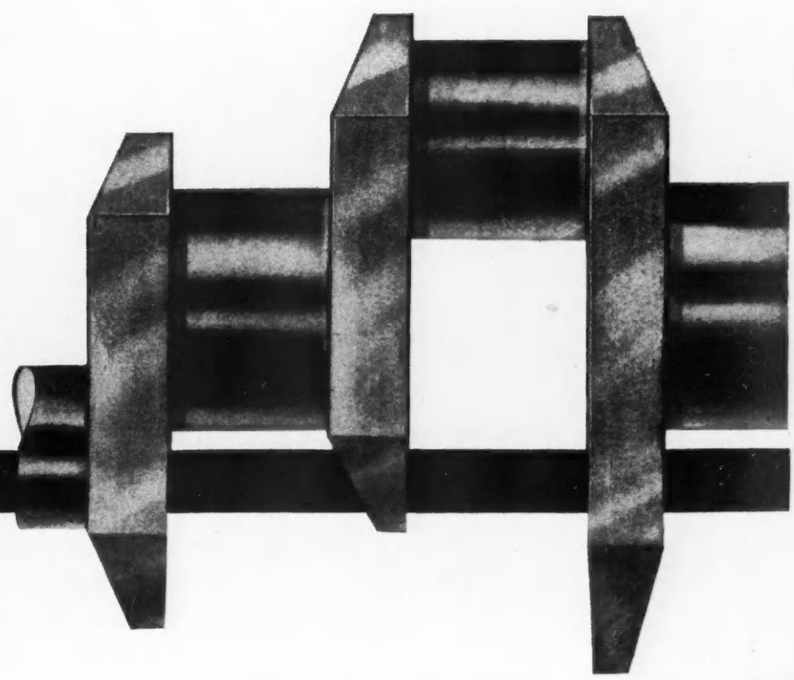

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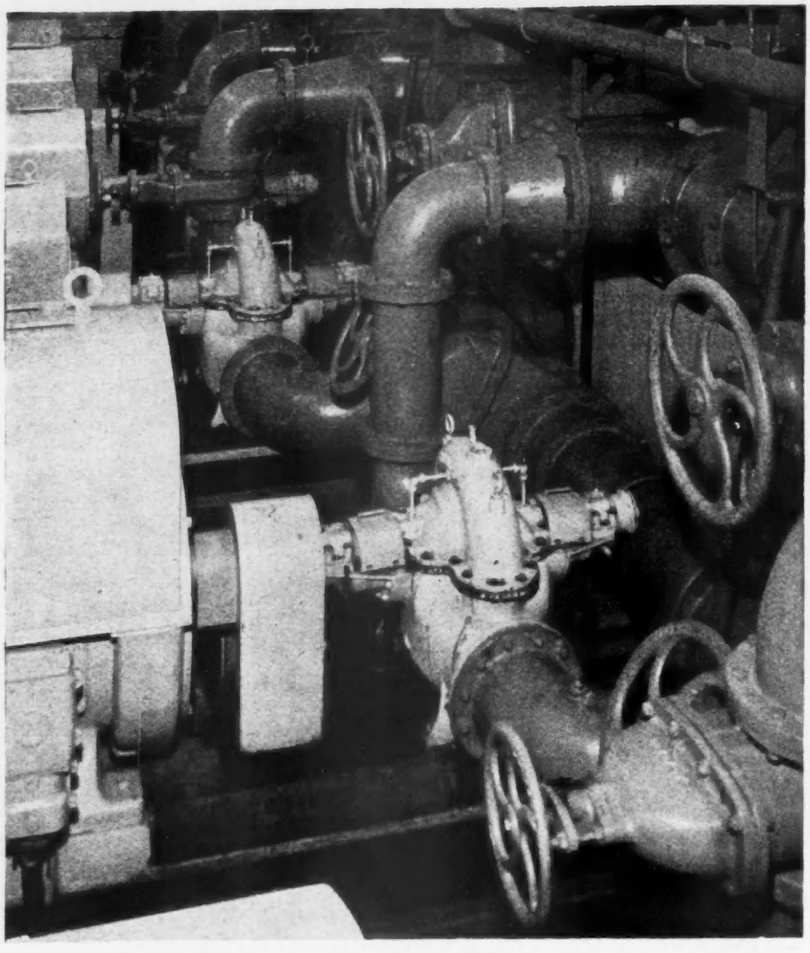
Gwynnes

Split-casing pumps



*Gwynnes double entry Split-casing pumps are made up to the largest sizes for both Horizontal and Vertical Spindle arrangements.

The photograph shows Gwynnes 10″ and 12″ pumps supplied to the order of the Woodhall-Duckham Construction Company for the Avenue Carbonisation Plant, Chesterfield, of the National Coal Board.

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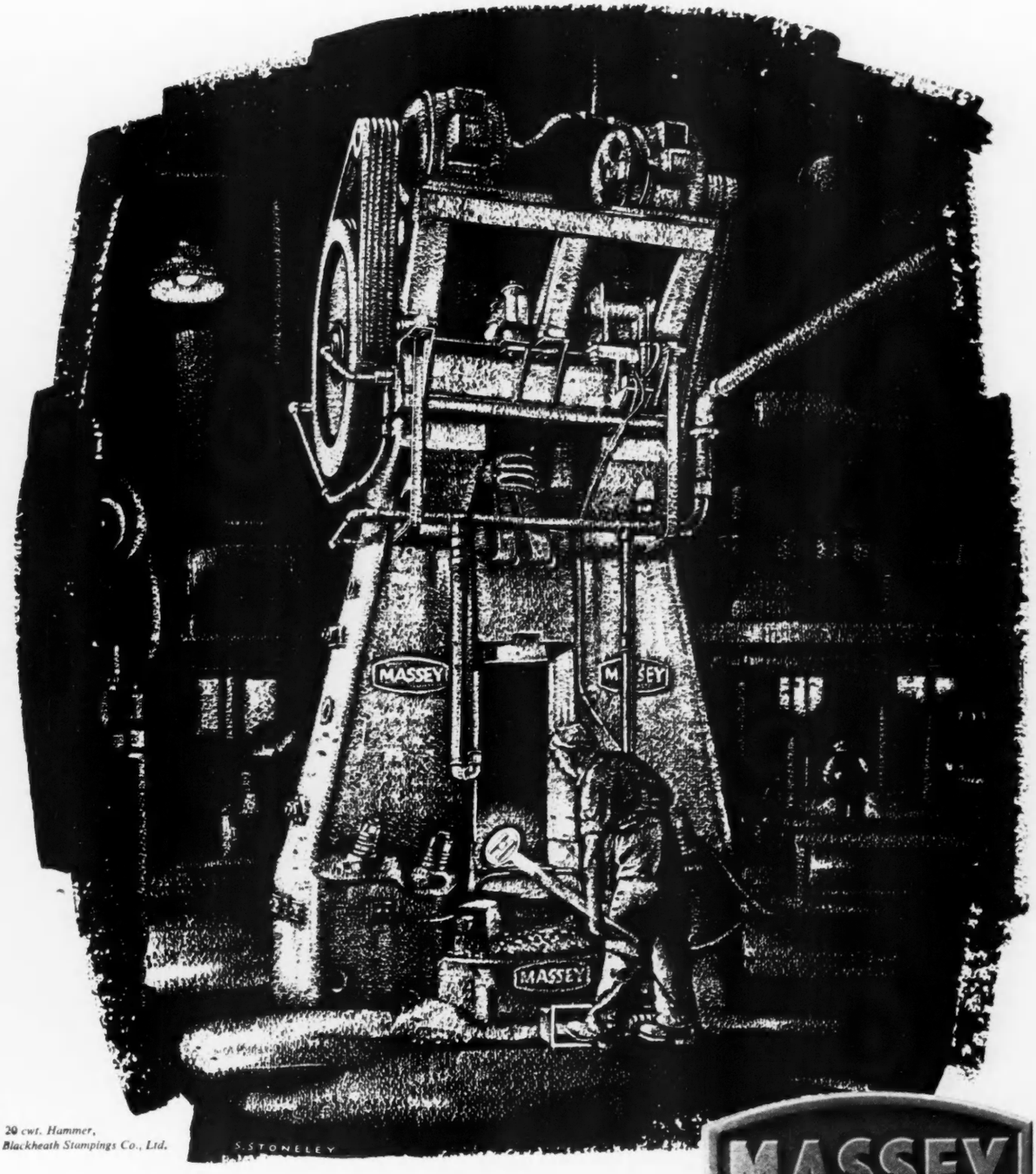

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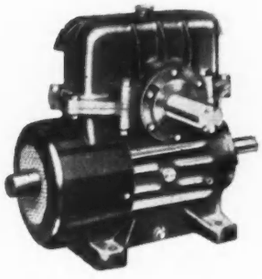

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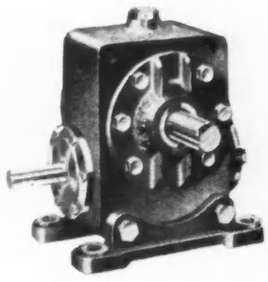

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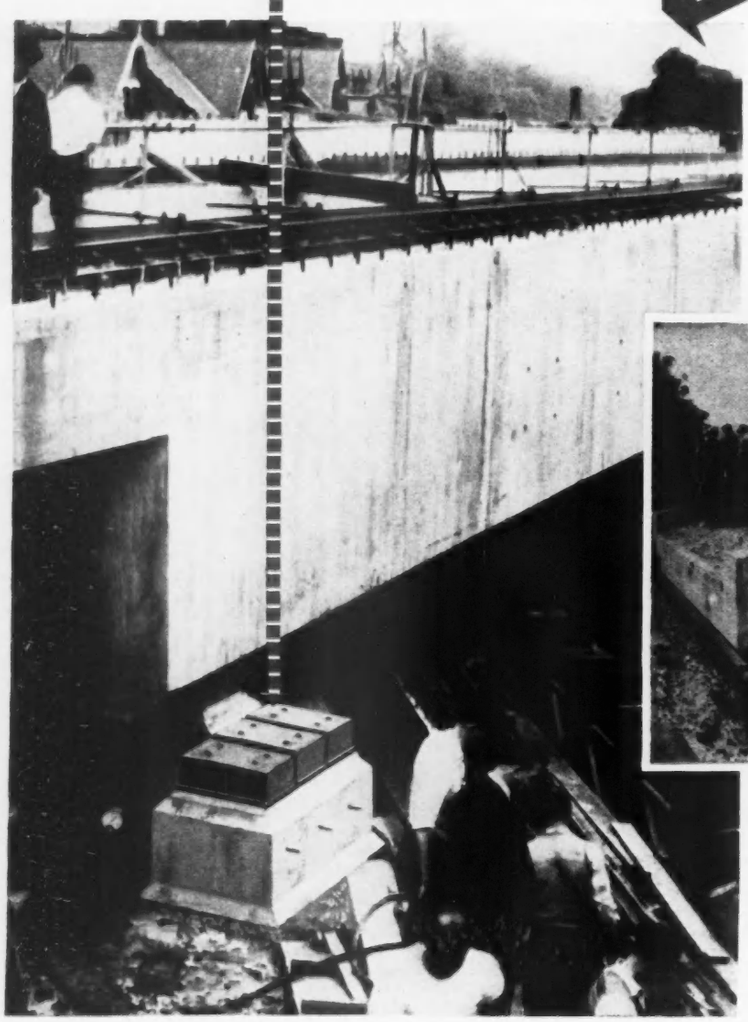
Andre Rubber have now produced the rubber bearings for the new Stockbridge Road bridge under construction on the London Midland Region main line to Manchester. The wide range of load fluctuations and other special problems involved in the design of this bridge were tackled successfully by the Andre Rubber team of experts.

Photograph by courtesy of British Railways



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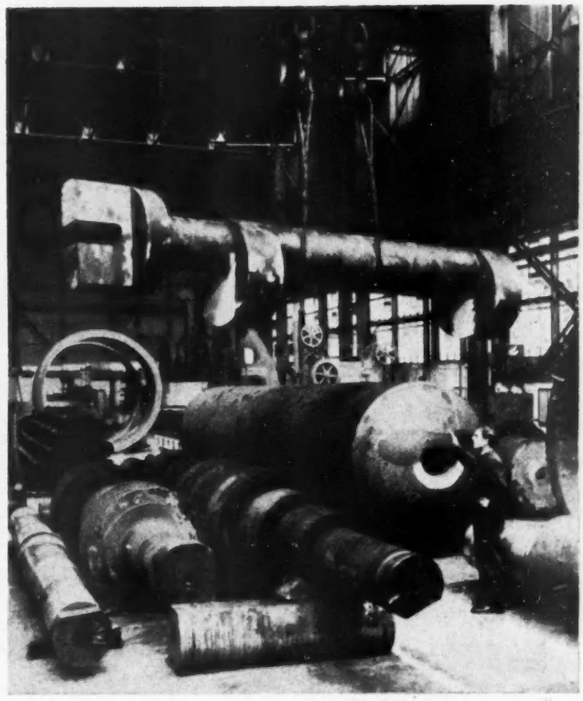
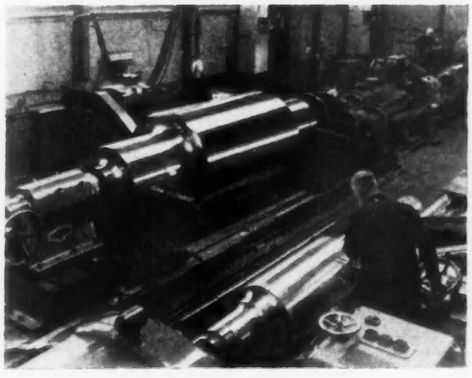
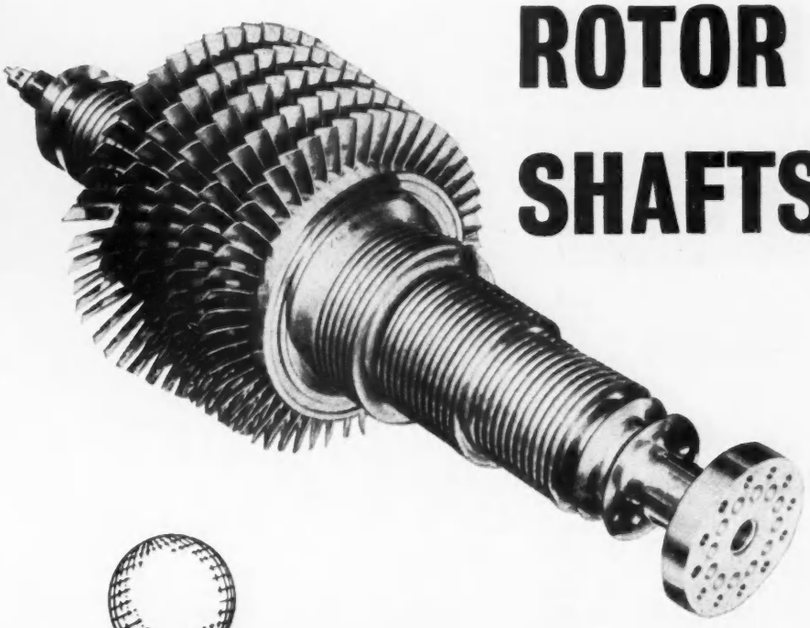




ROLLS and ROTOR SHAFTS



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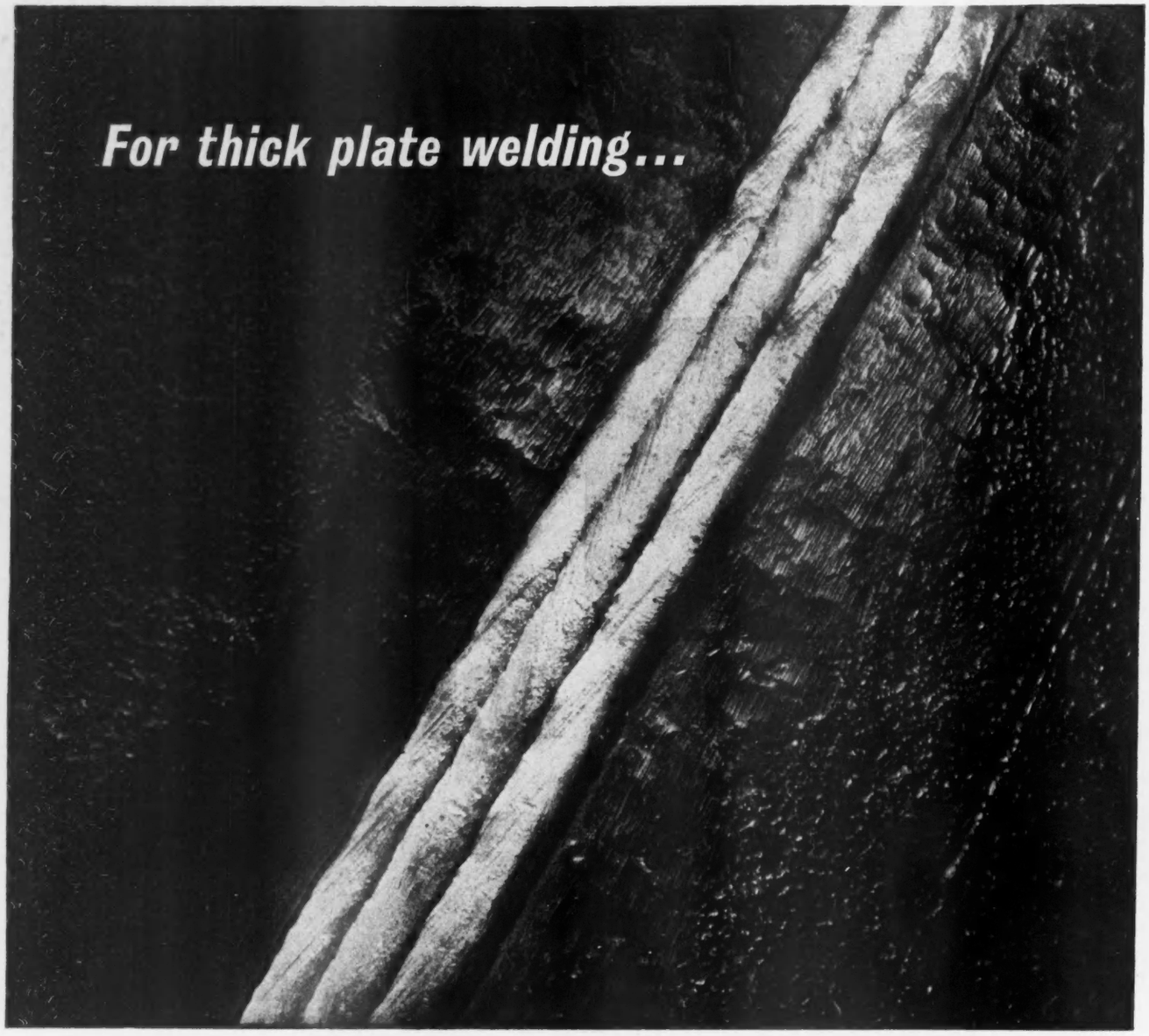
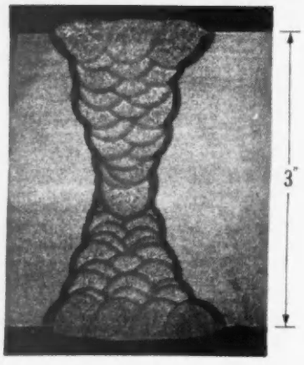


Murex "Muraflux A"
submerged-arc welding flux



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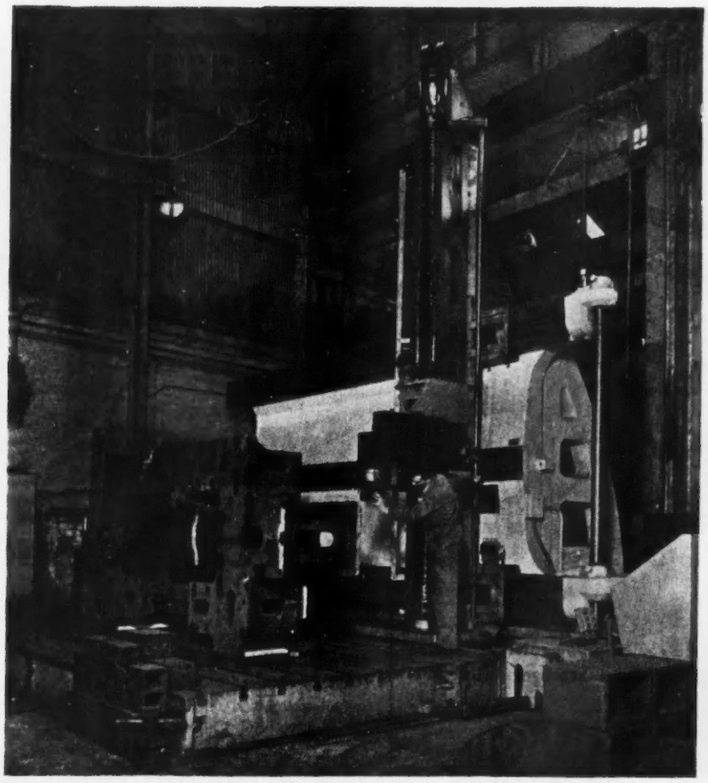

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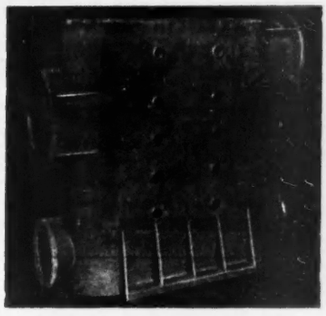

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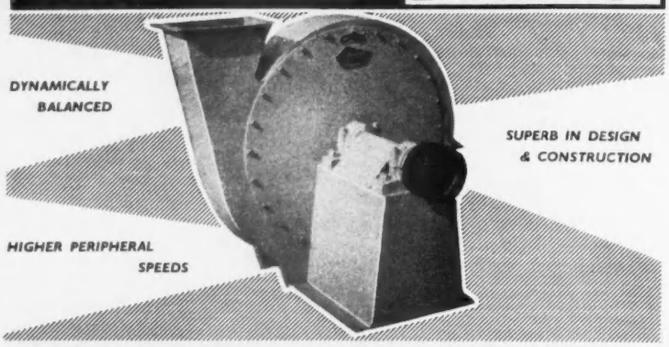

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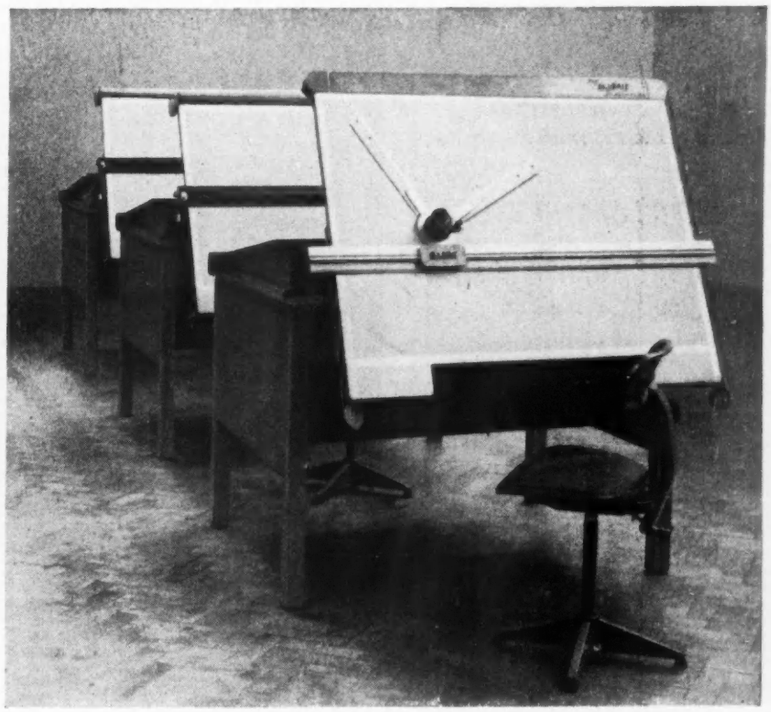

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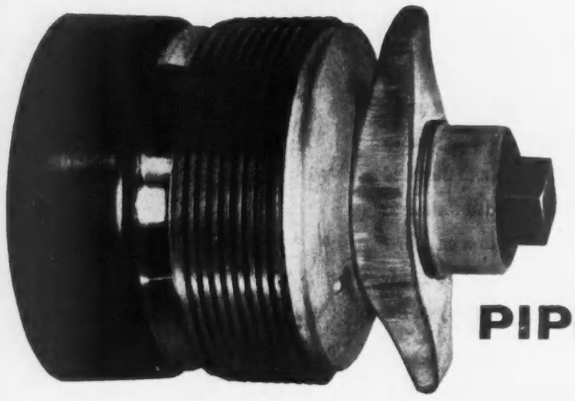

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The cone lock pipe stopper in position.

The stopper is easily removed after testing by slackening the wing nut.

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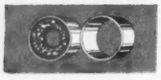

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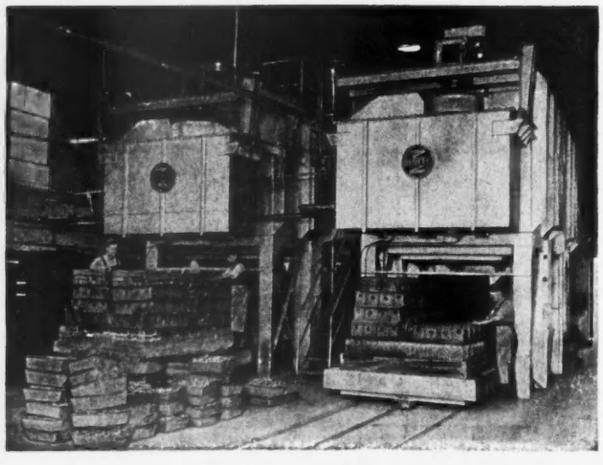
CLIVE FOUNDRY . LEAMORE . WALSALL



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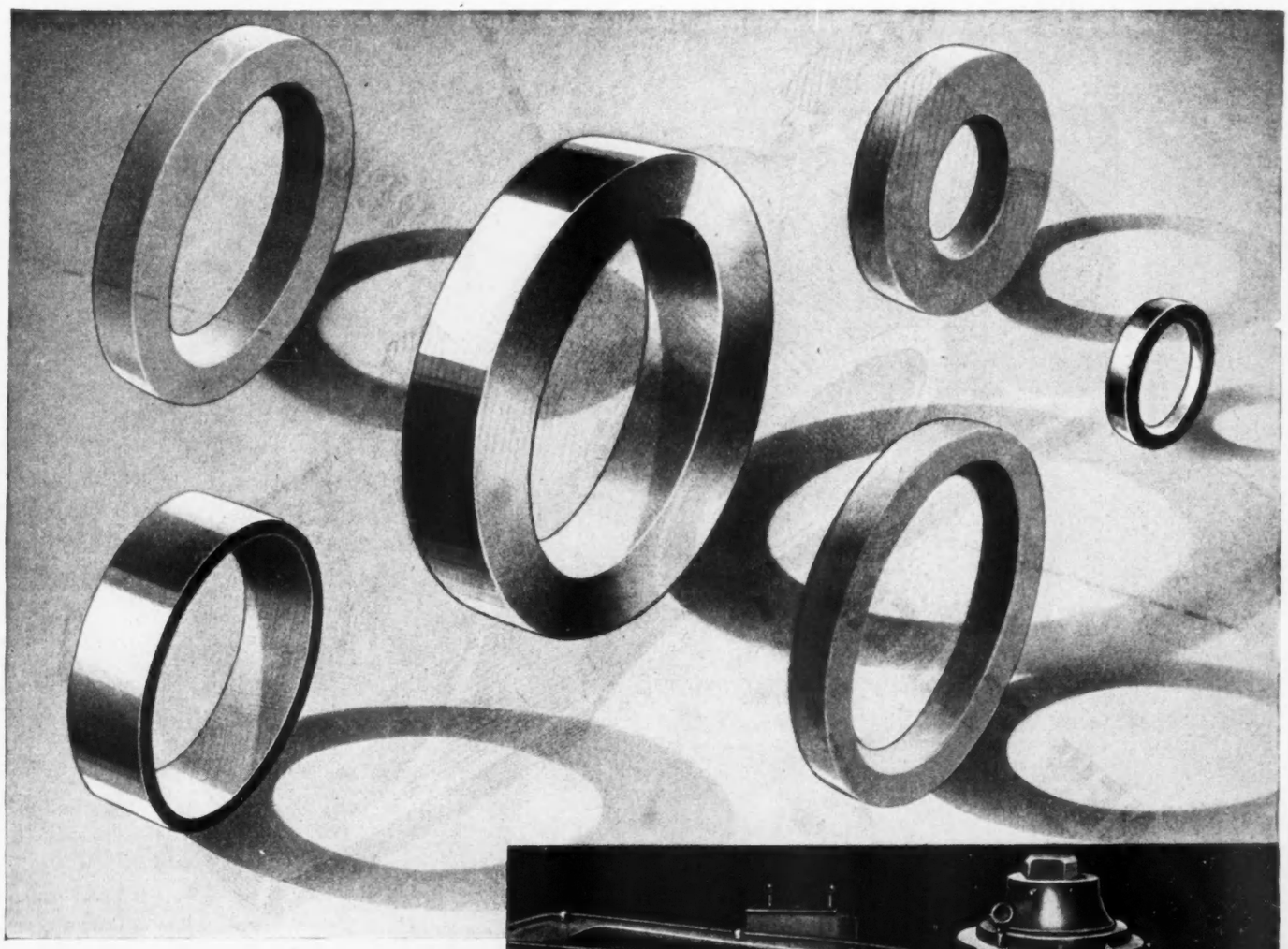

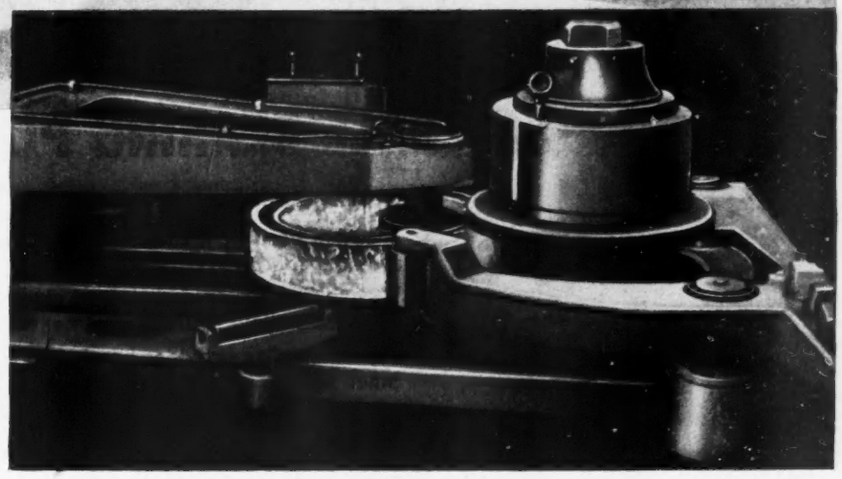

ROLLED *and* FORGED STEEL RINGS . . .

Our new Ring-rolling machine is now in full production. A wide range of forged and rolled rings is now available in alloy and carbon steels.

Forged rings up to 112″ O.D.
Rolled rings from 78″ O.D. to 20″ I.D.
Upset punched rings down to 6″ O.D.

WALTER SOMERS LIMITED
HALES OWEN · NR. BIRMINGHAM

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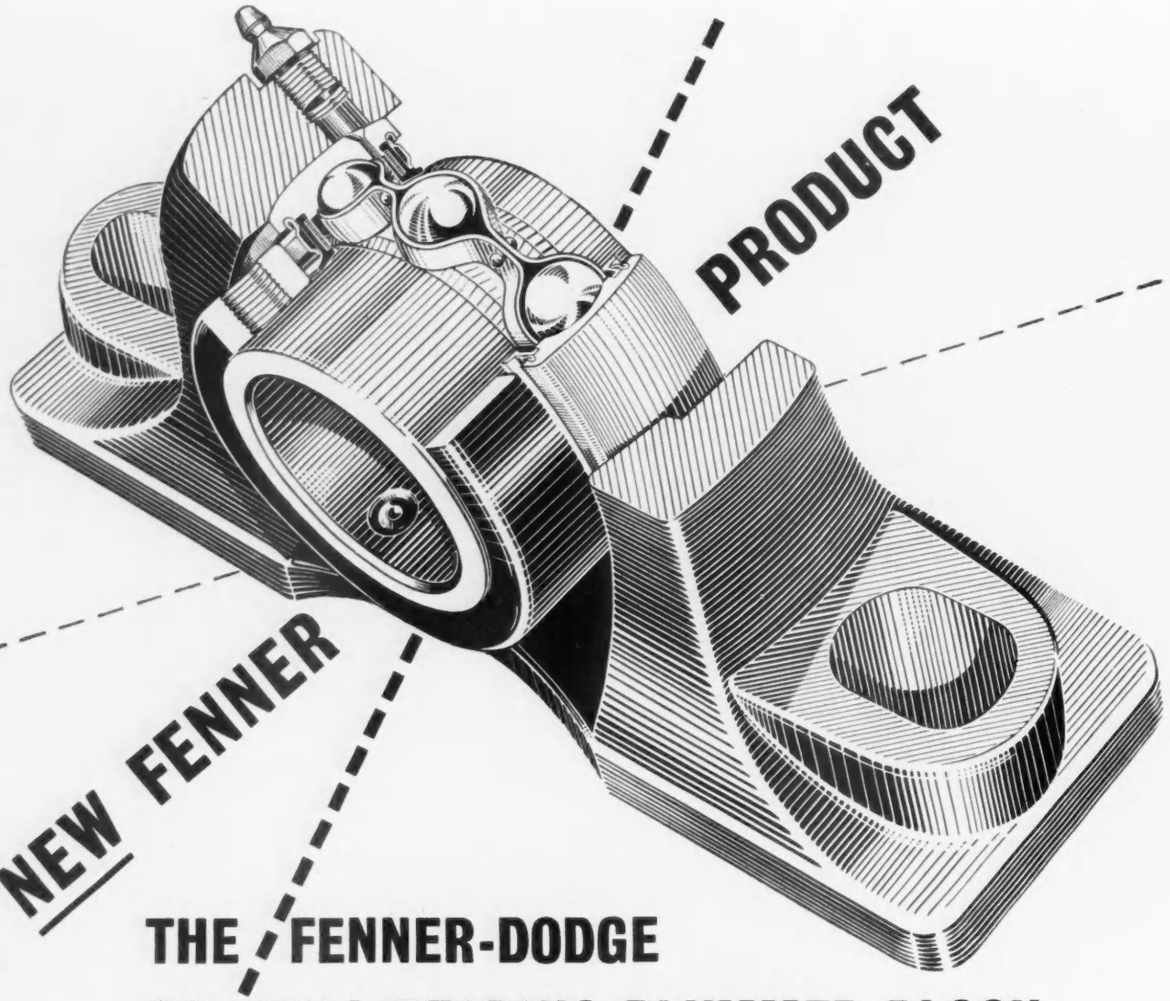


A NEW FENNER PRODUCT

THE FENNER-DODGE SC BALL BEARING PLUMMER BLOCK

with these special 5 star features :-

★ A sealed bearing with relubrication facilities giving longer life under arduous conditions.

★ Easy to fit housing designed to give adequate spanner room and elongated bolt holes allow lateral adjustment.

★ Separate collar provides bearing to shaft fixing without distortion of inner race.

★ Special seal designed for low frictional losses and keeps grease in and dirt out.

★ Deep groove ball bearing with long inner race distributes loads over greater shaft area, and is fully self aligning.

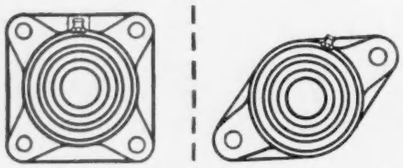
Send for leaflet 250/19

Fenner

J. H. FENNER & CO. LTD., MARFLEET, HULL

BRANCHES AT: *BELFAST, BIRMINGHAM, BRADFORD, BRISTOL, BURNLEY, CARDIFF, GLASGOW, HULL, LEEDS, LEICESTER, LIVERPOOL, LONDON, LUTON, MIDDLESBROUGH, MANCHESTER, NEWCASTLE-ON-TYNE, NOTTINGHAM, SHEFFIELD, STOKE-ON-TRENT.*

ALSO AVAILABLE IN



4 BOLT FLANGE BEARING | 2 BOLT FLANGE BEARING

LARGEST MAKERS OF V-BELT DRIVES IN THE COMMONWEALTH

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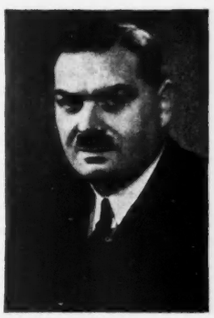
R. H. Campbell
SALES DIRECTOR
STOCKPORT

Bob Holland
BIRMINGHAM



Worldwide

Bill Budd
MONTREAL

You may know some of the men who sell WHARTON cranes. But you won't know the men who actually build them. And that's a pity.

We know them. We know the excellence of their work, the skill and experience which they use to such good—and lasting—effect.

Eric Ward, for instance. He began learning about WHARTON cranes when he joined our machine shop 39 years ago, to be followed 25 years later by his son Donald.

"It's the sort of place," says Eric, "where you can put your heart into the job and know that people appreciate your work. And there's always plenty of it. I've been on overtime since 1927."

It's natural that the Wards and others like them are busy. Because people DO appreciate cranes built by such craftsmen . . . WHARTON cranes.

THE WHARTON CRANE & HOIST CO. LTD.

REDDISH STOCKPORT ENGLAND

Phone : Heaton Moor 2227 Grams : "Gallant, Manchester." Code : Western Union

LONDON: Lincoln House, 296/302 High Holborn W.C.1.
SCOTLAND : Fisher-Baxter & Co., 140 West George Street, Glasgow C. 2.
MIDLANDS : A. R. Holland & Son, 89 Cornwall Street, Birmingham, 3.
SOUTH-WEST : R. C. Collins, 48 Westbourne Road, Penarth, Glamorgan.
NORTHERN COUNTIES : Fisher-Baxter & Co., 140 West George Street, Glasgow C. 2.
NORTHERN IRELAND : General Engineering Products Ltd., 7/9, Great Patrick Street, Belfast.
EIRE or SOUTHERN IRELAND: Charles Nolan & Co., 2 Porter Hill, Lower Rathmines Road, Dublin.
CANADA : Hamilton Equipment Co. Inc., P.O. Box 28, 61 Victoria Avenue, Dorval Station, P.Q.

Phone : Clissold 7911. Grams : Clissold 7911.
Phone : Douglas 1061-2-3. Grams : Passover, Glasgow.
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REPRESENTED IN PRINCIPAL COUNTRIES THROUGHOUT THE WORLD

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Silicones for the engineer

MS MIDLAND SILICONES LTD

MS

Silicone rubber insulated cables defy heat

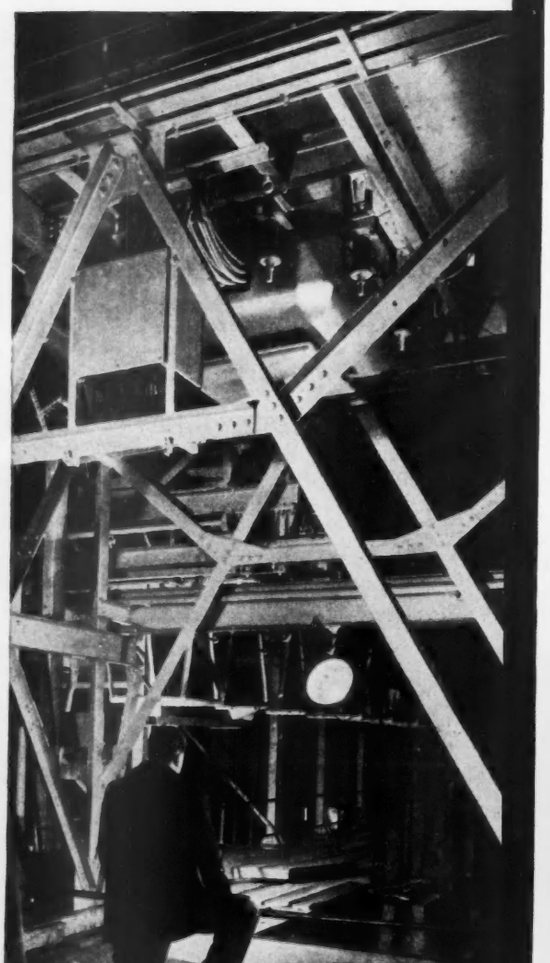
Silicone rubber insulated cables are used to supply the furnace heater batteries at the Rogerstone plant of Northern Aluminium Co Ltd and operate at an average temperature of 135°C. Each cable is 2200/.0076" single conductor tinned copper wire, silicone rubber insulated, asbestos roved, glass braided and silicone varnished—C.M.A. 660V grade.

The advantages of silicone rubber insulated cables are that they:

- *Give continuous long term operation in ambient temperatures up to 200°C
- *Will operate through and after fire
- *Are resistant to steam, water and many chemicals
- *Do not require any special terminating seals
- *Have excellent resistance to electrical fatigue and corona discharge
- *Are flexible at temperatures as low as -90°C

The silicone rubber insulated cables are installed above the quench tank (shown at the right) in which aluminium slabs are lowered after they have been taken from the furnace.

(Photograph by courtesy of Northern Aluminium Co Ltd)

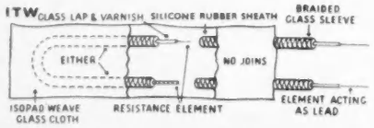


MS

Silastomer* Silicone rubber works where other materials fail!

Isopad Ltd specify Silastomer silicone rubber for covering their flexible heating tapes designed for operation at temperatures of up to 200°C in moist conditions. And for good reason. Silastomer retains its flexibility and excellent dielectric properties over an extremely wide temperature range—from −100°C to +250°C.

No organic rubber can match this performance and that is why Silastomer is specified by Isopad and many other manufacturers for all types of equipment and appliances where reliability is essential—from seals in domestic irons to resilient diaphragms in valves.

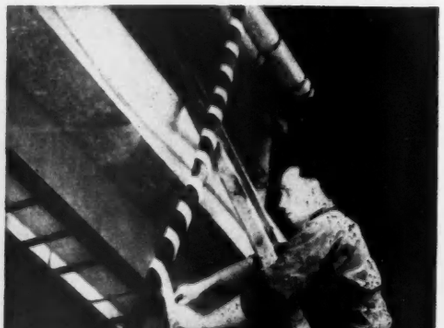


Isotape tape ITW showing the heating elements covered with Silastomer silicone rubber. This weatherproofs the Isotape and makes it suitable for a temperature range of −100°C to 222°C.

*Silastomer is a registered trade mark of Midland Silicones Ltd.

Isotapes being fitted to bitumen feed pipes

(Photograph by courtesy of Isopad Ltd)

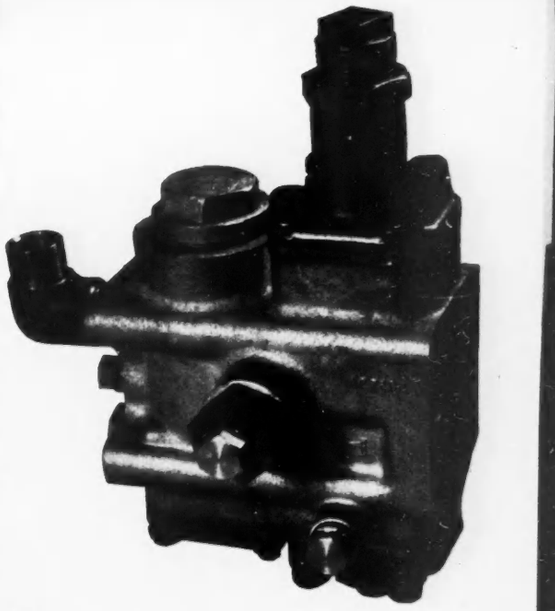


MS

Silicone greases remain serviceable from −70°C to +230°C

London Transport were experiencing considerable difficulty during cold weather due to the sticking of unloader valves on the compressors of their Green Line buses. An MS silicone grease solved the problem. Because of their outstanding resistance to extremes of temperature, MS silicone greases remain serviceable over a far wider temperature range than organic lubricants, thus providing reliability in operation and a reduction in maintenance costs. An MS silicone grease or lubricant may offer the most practical and economical solution to your most difficult lubricating problem.

The photograph shows the unloader valve fitted to Green Line buses. Courtesy of London Transport Executive.



Write for full information about these and the many other silicone products with applications in the engineering industry including release agents, damping and hydraulic fluids, heat-resistant paint resins, lubricants and electrical insulants.

MIDLAND SILICONES LTD
68 KNIGHTSBRIDGE • LONDON SW1
Tel: Knightsbridge 7801
Area Sales Offices: Birmingham · Glasgow · Leeds · London
Manchester · *Agents in many countries*

First in British Silicones

MS

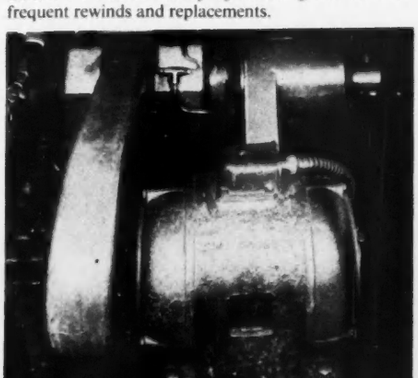
Silicone-insulated motors withstand years of continual 'plugging'

The photograph shows a silicone-insulated motor operating at the Stonehouse Works of Hoffman, Gloucester Ltd, who have kindly provided us with the following information—"We have a bank of 12 machines, each being driven by a 2 h.p. 1425 r.p.m. motor and as the motors have burnt out they have been rewound with silicone insulation, by British Electrical Repairs Ltd, and this has proved very satisfactory over the past 2/3 years.

"These motors are working in unusual conditions, as the following description of their working cycle shows, and they stand up to the work very well indeed.

"A complete operation takes 12 seconds then the machine is operated to reload which takes 2 seconds. To decelerate rapidly to the stop position for loading the operator presses the stop button followed by 'plugging' (pressing the reverse button). This is drastic treatment when continued all day and speaks well for the rewound motors".

This is a typical example of how MS silicone insulation increases the life and reliability of hard-working motors . . . saves money by reducing the need for frequent rewinds and replacements.



MS

Silicone fluids speed production at Mullards

An MS silicone fluid is used in the SPEEDIVAC* vacuum diffusion pumps which serve each plant of this rotary machine for producing Radiant Screen television tubes at the Mullard Television Tube plant at Simonstone. Because of the excellent heat stability and oxidation resistance of the silicone fluids, cooling of the pumps before releasing the vacuum is not necessary. Rapid cycling is therefore possible resulting in more efficient production.

*Trade name of Edwards High Vacuum Ltd

Because of their versatility MS silicone fluids overcome many of the limitations of organic fluids and open the way to improvements in the design of equipment and in production techniques. Advantages include:

* Serviceable temperature range from −100° to 450°F
* Available in viscosities from 0.65 to 1,000,000 centistokes
* High flash points
* Low vapour pressure
* Excellent oxidation resistance
* Low coefficient of expansion
* High degree of compressibility

Write for Silicone Notes G11 which details many of the applications of MS fluids.

(Photograph by courtesy of Mullard Limited)

MS

Cold-Cure Silastomer* aids diesel design research

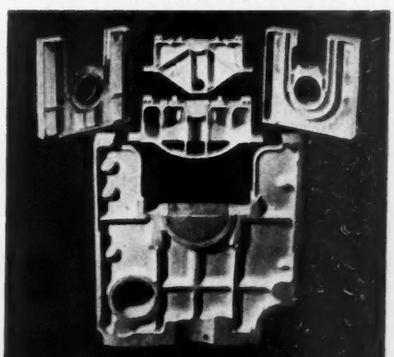
Cold-Cure Silastomer–the silicone rubber that needs no heat to cure–is used for making scale models of diesel engine components to enable their behaviour to be studied under different simulated loads. Wooden moulds are made, assembled and painted with a release agent and the Cold-Cure Silastomer is poured in and left to set. No special equipment is needed and the models are ready for use in about 24 hours after casting at room temperature.

Cold-Cure Silastomer is remarkably versatile and opens up new fields for designers. The addition of a catalyst is all that is required to cure at room temperature and the material possesses the excellent dielectric properties, heat endurance and high thermal conductivity associated with silicone rubbers. Cold-Cure Silastomer can be used by unskilled operators to fill voids round lead wires of coils and motors, for impregnating coils, and for other similar sealing or potting applications. It can also be used for making flexible moulds in which epoxide resins are cast.

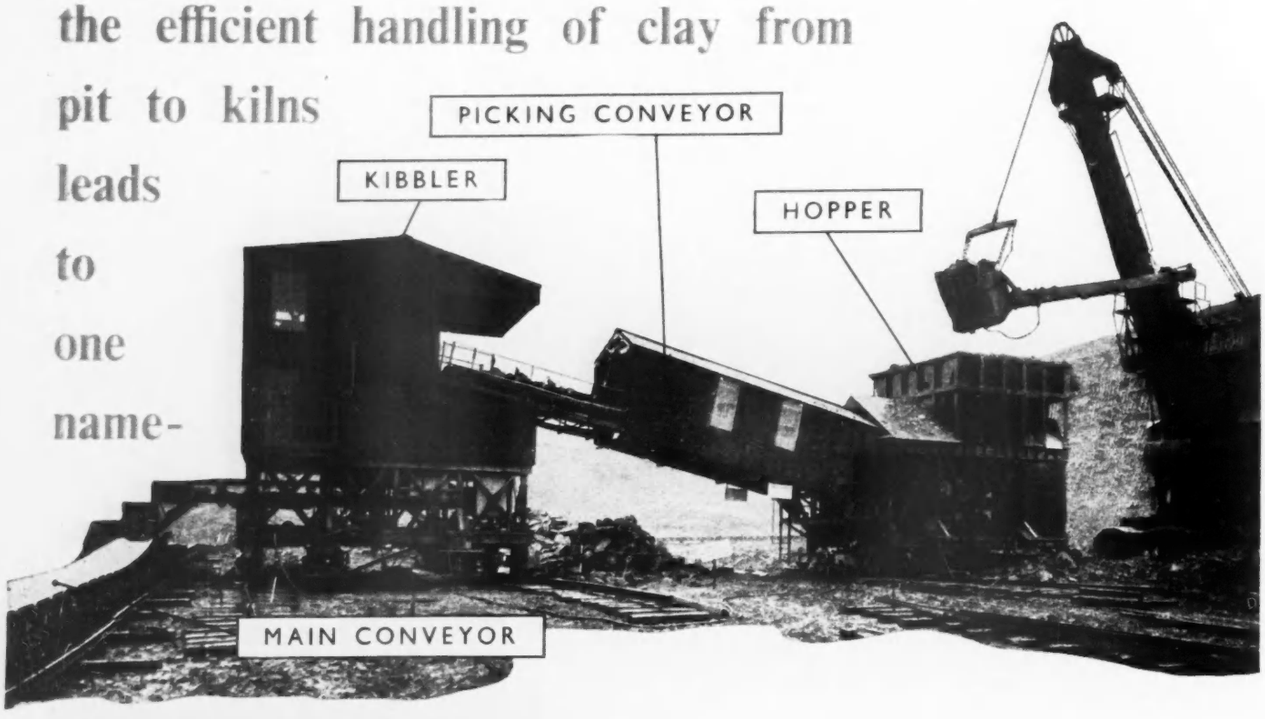
Write for a sample—on your company letterhead please–of either Cold-Cure Silastomer 9160 or 9161. The former has a spreadable consistency and the latter is suitable for dipping. Silicone Notes K28 is also available listing the properties and applications.

*Silastomer is a registered trade mark of Midland Silicones Ltd

(Photograph by courtesy of Ruston & Hornsby Ltd)



Not just piecemeal, but comprehensively, the efficient handling of clay from pit to kilns leads to one name-



Sutcliffe

BRITAIN'S BEST CONVEYORS

These units are designed to travel *together* and follow the excavator. They form the first stage in a conveying system totalling over 7,000 feet to the storage sheds. Such installations are designed for continuous working on exposed sites with the minimum of maintenance and are typical of many industrial projects designed and manufactured by us at Horbury for use at home and abroad.

Not all Sutcliffe customers operate on this scale however, and whether you require one idler or a complete installation our knowledge and enthusiasm are equally at your service.

BACKFILLING OF CALLOW, TOO!

The installation referred to handles 500 tons per hour and is complete with a waste conveyor. Pictured is a Sutcliffe tripper and jib spreader conveyor, backfilling callow into an old working.

RICHARD SUTCLIFFE LIMITED
HORBURY WAKEFIELD

dmR517

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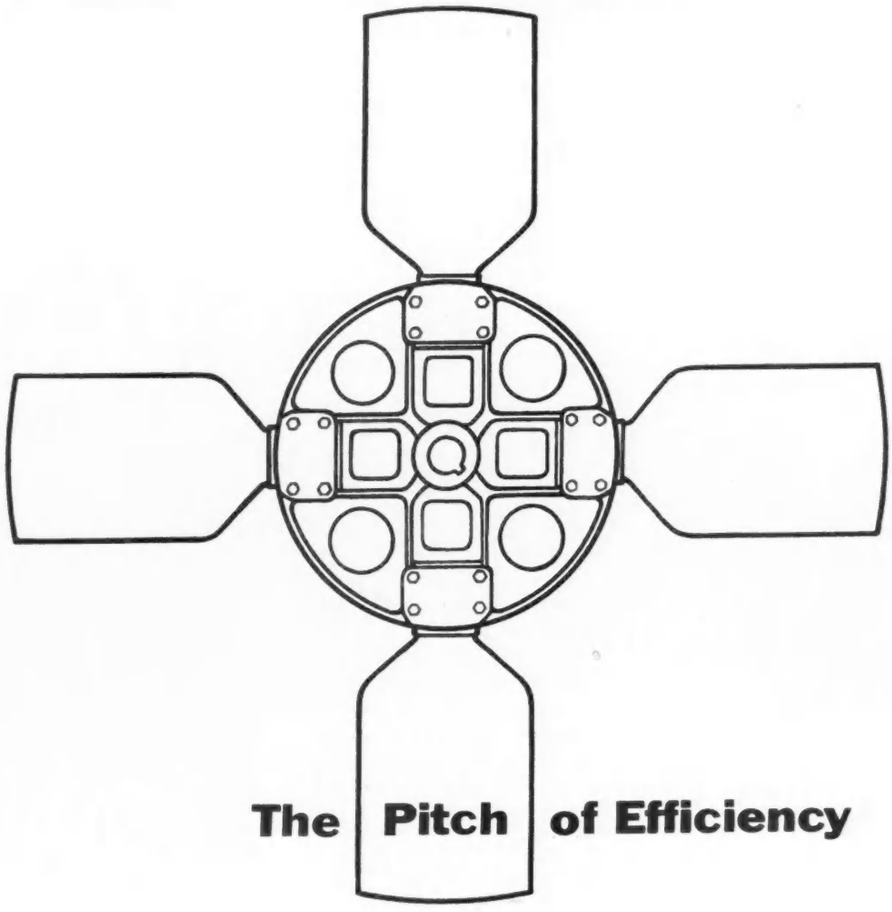
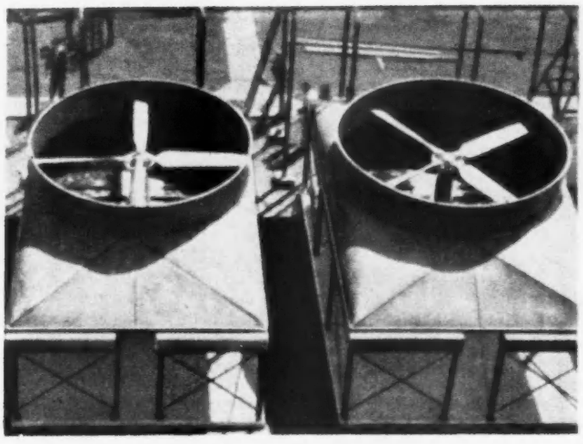


The Pitch of Efficiency

A cooling fan with blades set at exactly the right pitch for the job saves power and prevents needless wear and tear of equipment.

Aeromaster Adjustable Pitch fans are bringing the same economical trouble-free performance to cooling plants that Hordern Richmond airscrews and helicopter rotors have brought to flying.

Send for new folder: "Air Moving Without Power Waste."



Aeromaster

ADJUSTABLE PITCH
INDUSTRIAL FANS

HORDERN RICHMOND LTD.,
BRISTOL ROAD, GLOUCESTER · *GLOUCESTER 24941.*

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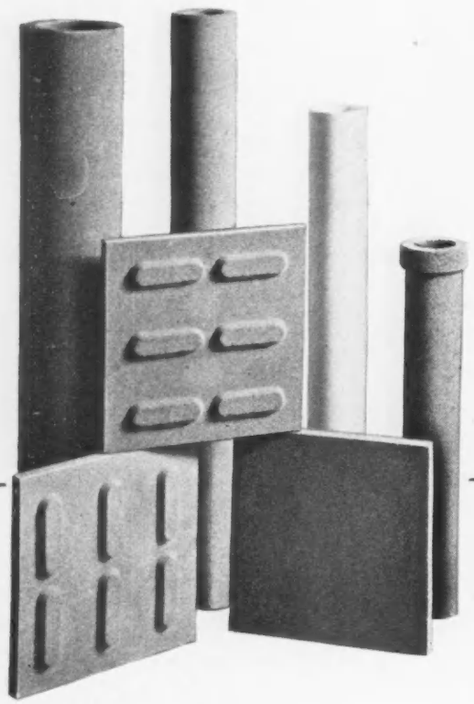

Versatile and Consistent

AEROX POROUS CERAMICS with outstandingly uniform pore density serve industry *in a thousand ways:*

As FILTERS for compressed air or gas to eliminate solid particles and liquid droplets; sterilisation; cleaning of exit gases; recovery of valuable solids from liquors, etc., etc.

As DIFFUSERS for effluent treatment; gas absorption; flotation processes, etc., etc.

As DIAPHRAGMS for electrolytic processes.

As a POROUS BASE for fluidised discharging, conveying and fluid bed reaction processes.

CAN YOU SUGGEST THE 1001st?

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LEADERS IN A SPECIALISED FIELD

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Metcalfe's High Pressure Washing Plant

SUITABLE FOR ALL INDUSTRIAL APPLICATIONS

The "Metcalfe's" High Pressure Washing Plant provides the answer to the problem of cleaning in industry to-day. The plant is supplied on a suitable hand truck for portable use or it can be fitted as a permanent installation, and the only services required to operate it are:

(1) Water supply (static or mains). The consumption is 550 gallons per hour.

(2) Steam supply at any pressure above 60lbs. per square inch. The consumption is 700lbs. per hour.

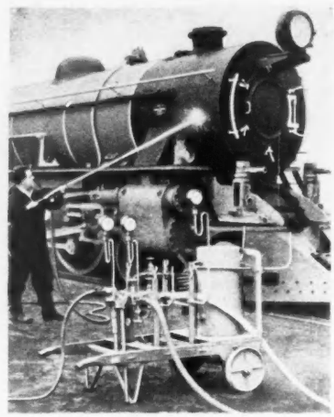

Photo by kind permission of the Vulcan Foundry Ltd
CLEANING A LOCOMOTIVE

The Washer is extremely simple to operate and can be easily operated in complete safety by unskilled personnel. The high temperature and pressure of the jet make it unequalled for power and efficiency and the use of cleaning solutions is not normally required.

CLEANING A SLAUGHTER-HOUSE FLOOR

ADVANTAGES OF THE 'D & M' SYSTEM OF WASHING

- (1) Delivers an extremely hot supply of water at a very high pressure thus ensuring the most efficient cleaning.
- (2) Ensures a great reduction in cleaning costs, due to the saving in man hours which is always found.
- (3) The injector is perfectly automatic and re-starting and requires no attention once the water valve has been set for the usual working pressures.
- (4) It will operate satisfactorily with low steam pressures (60lbs. per square inch upwards).
- (5) It can be operated with perfect safety and satisfaction by a non-skilled labourer.
- (6) Simple, compact and light.
- (7) No detergents or cleaning solutions are normally necessary.
- (8) No other system offers the same flexibility at low operating costs, low maintenance and low installation costs as the Metcalfe High Pressure Washing Plant.
- (9) A wide range of jet temperature and pressure is available so that the apparatus is suitable for all types of requirements.

WRITE FOR LEAFLET S.11

DAVIES & METCALFE LTD

INJECTOR WORKS · ROMILEY · MANCHESTER

Telegrams: EXHAUST, ROMILEY *Telephone: WOOdley 2626 (2 lines)*

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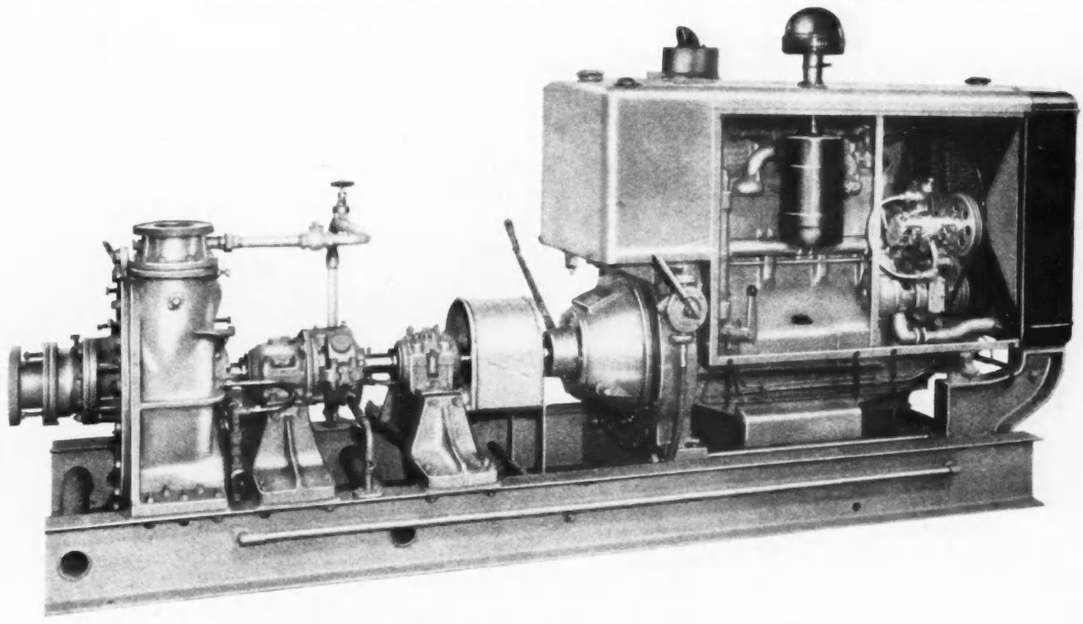
GRAVEL PUMPS



4½/5" Centrifugal Sand and Gravel Pump with Diesel Engine Drive

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TELEPHONE 3146 GRAMS: EASTWALD, TAUNTON

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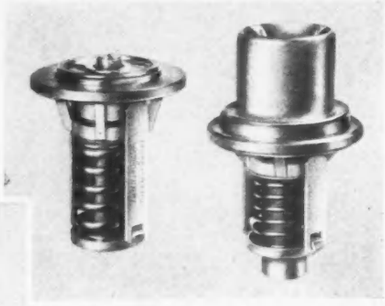
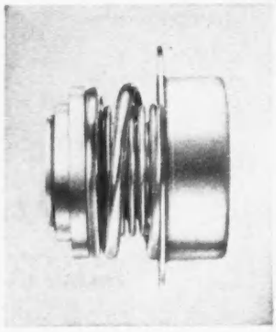
it must be **Teddington**

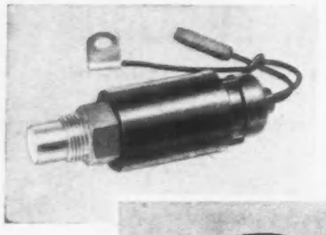
WAX-CHARGED COOLANT THERMOSTATS

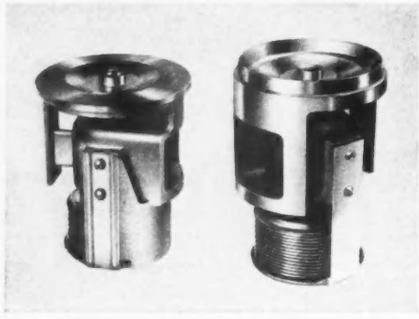




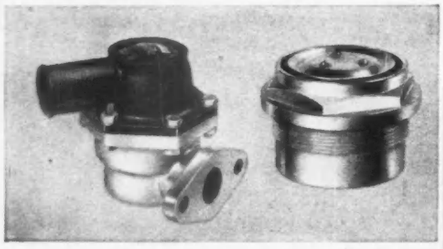
SHAFT SEALS

HEAVY DUTY TEMPERATURE AND PRESSURE SWITCHES

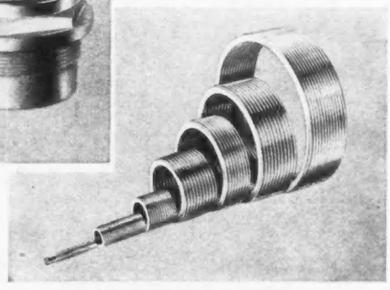




ENGINE COOLANT THERMOSTATS



PRESSURE RELIEF VALVES



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Every **Teddington** *product is backed by 30 years experience*

Ask for full technical details or call our Advisory Service

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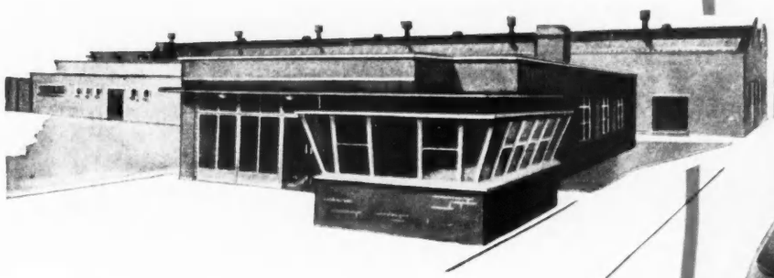

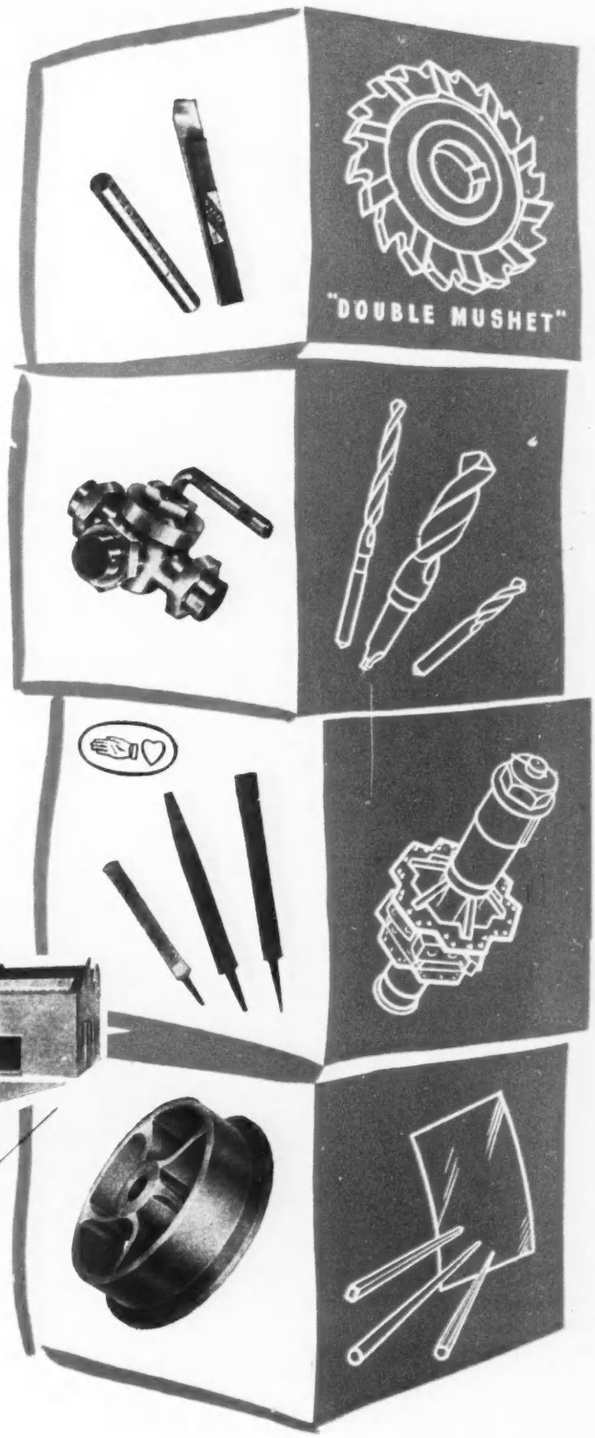

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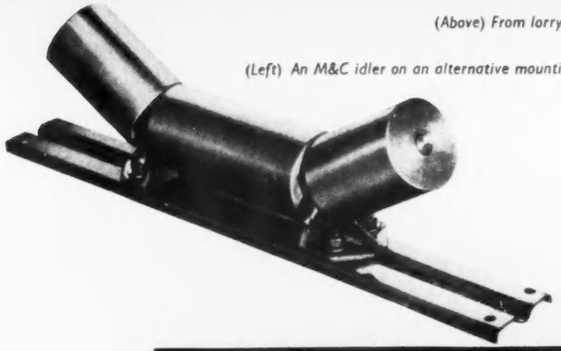
(Above) *From lorry hopper to washing plant by M&C sectional belt conveyors.*

(Left) *An M&C idler on an alternative mounting—a corrugated idler-board.*



At a large quarry in the Midlands, crushed granite had to be taken from lorries to the washing plant partly seen in the distance. Between was a waste area of tip-heaps. With little preparation of the ground, M&C sectional belt conveyors were laid over the soft piles, forming a reliable road open in all weathers. The wind blows dust and grit about but that does not worry the M&C idlers, which keep on carrying the belts with great ease and at low cost.

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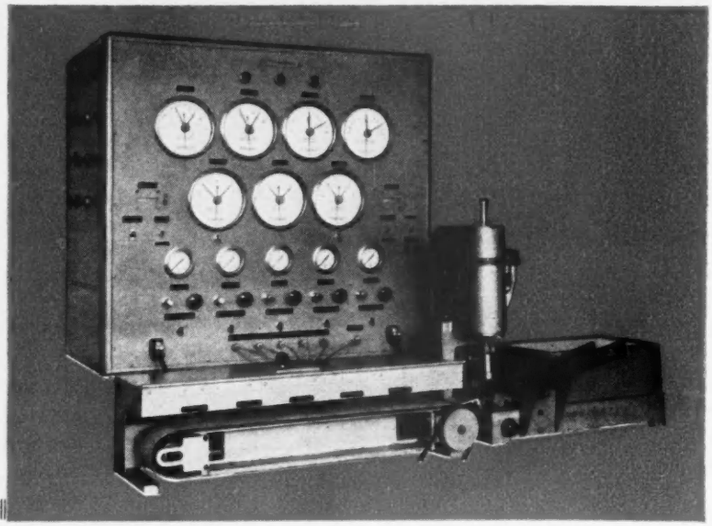

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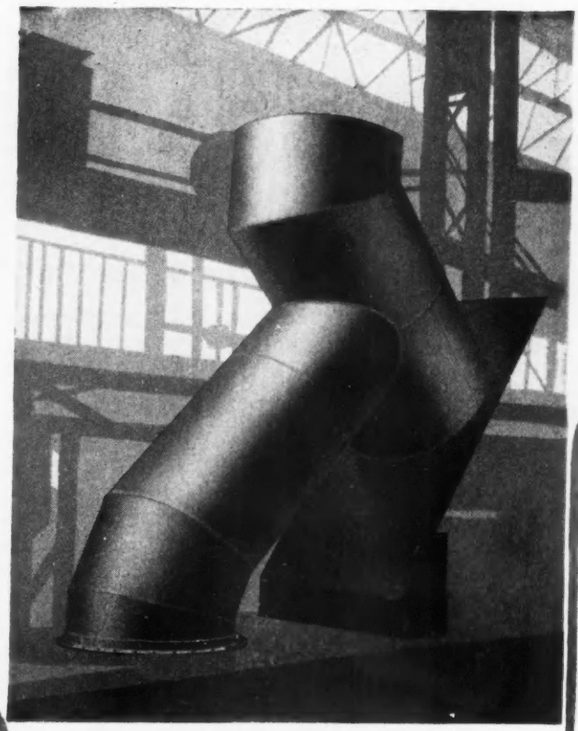

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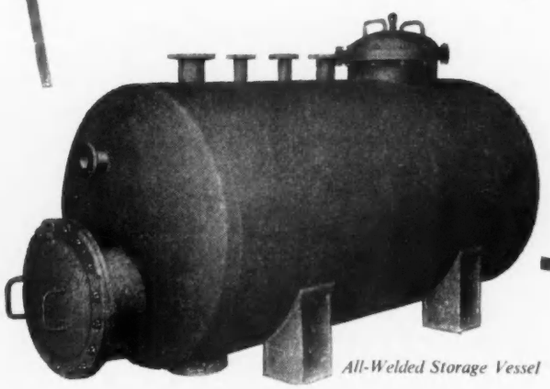

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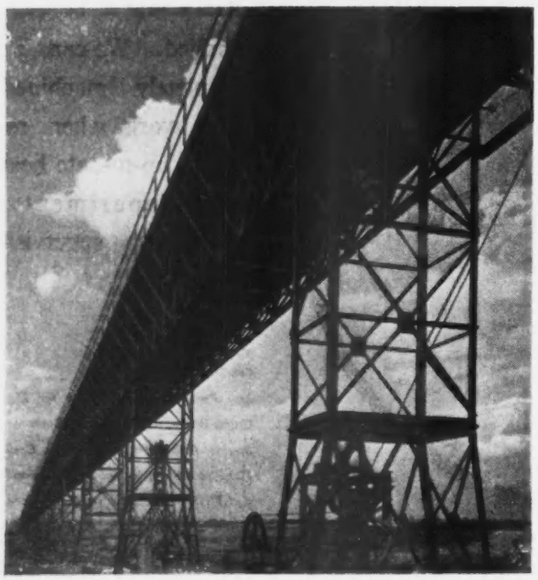

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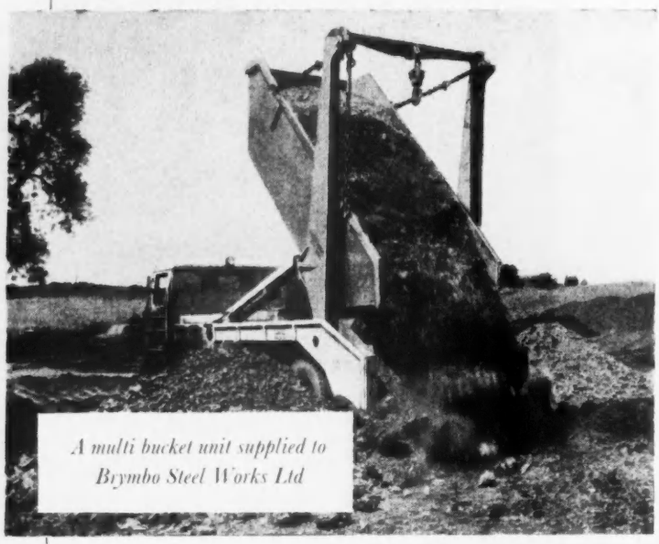
New concept of bulk handling

Bennes Marrel units for planned operations



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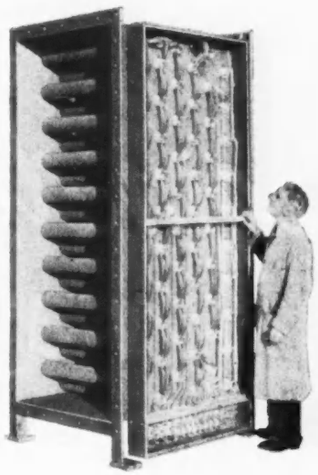

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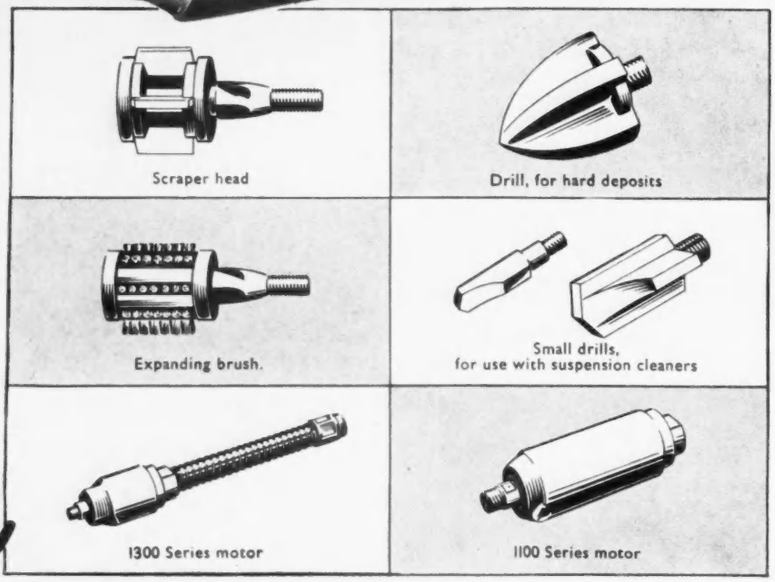

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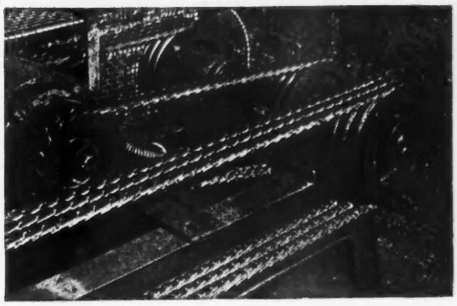

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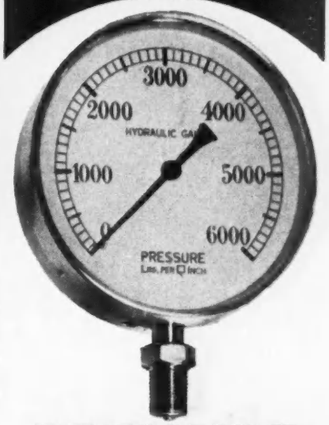

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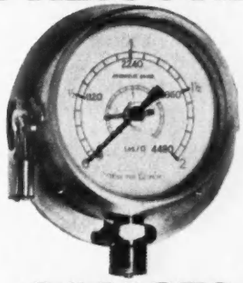

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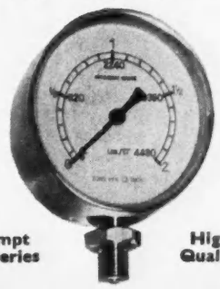

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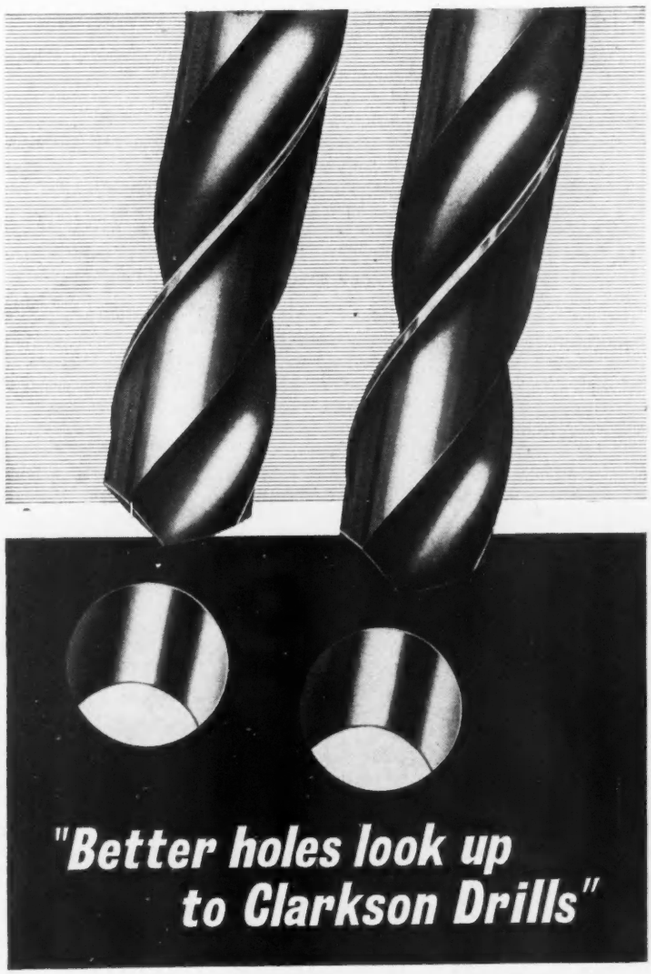

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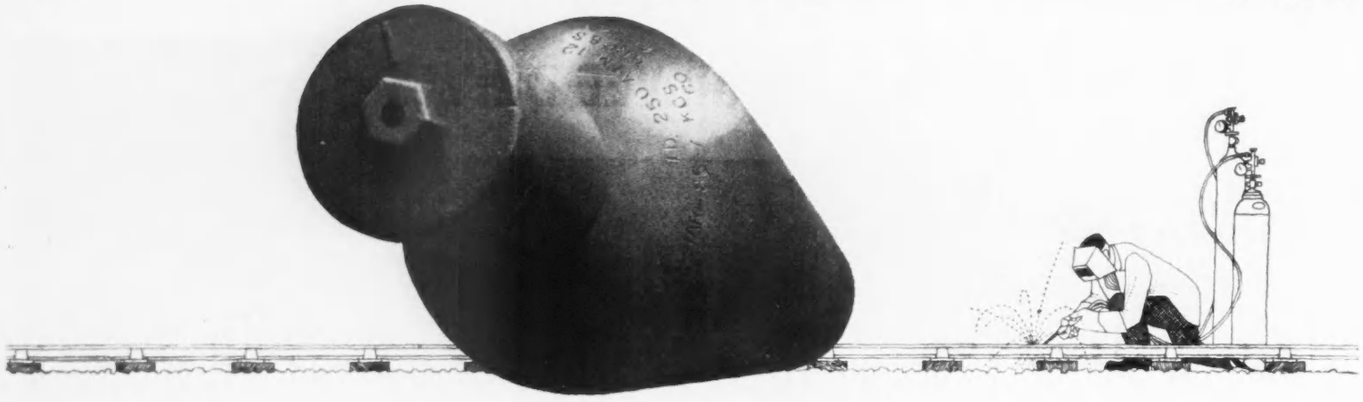

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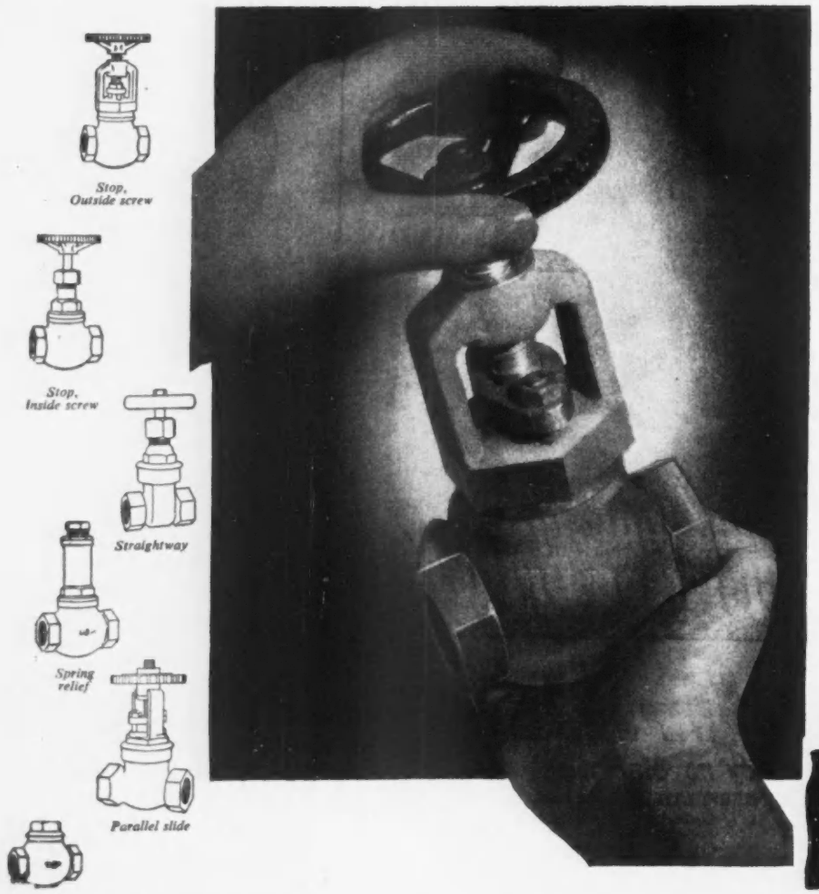

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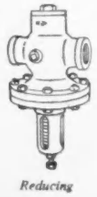

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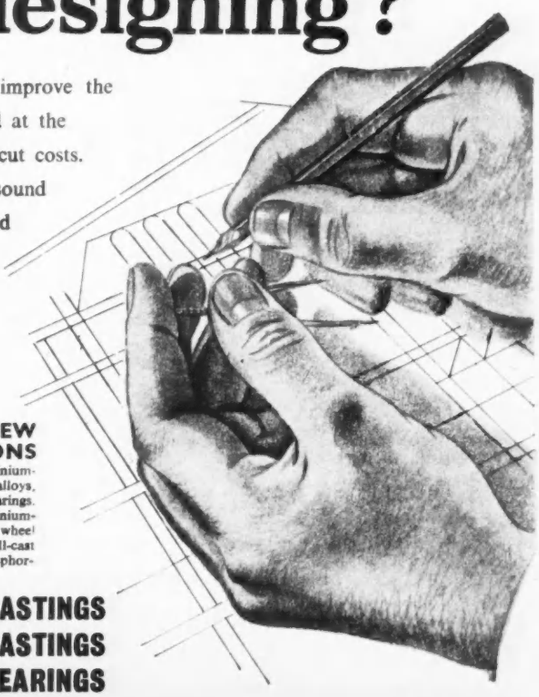

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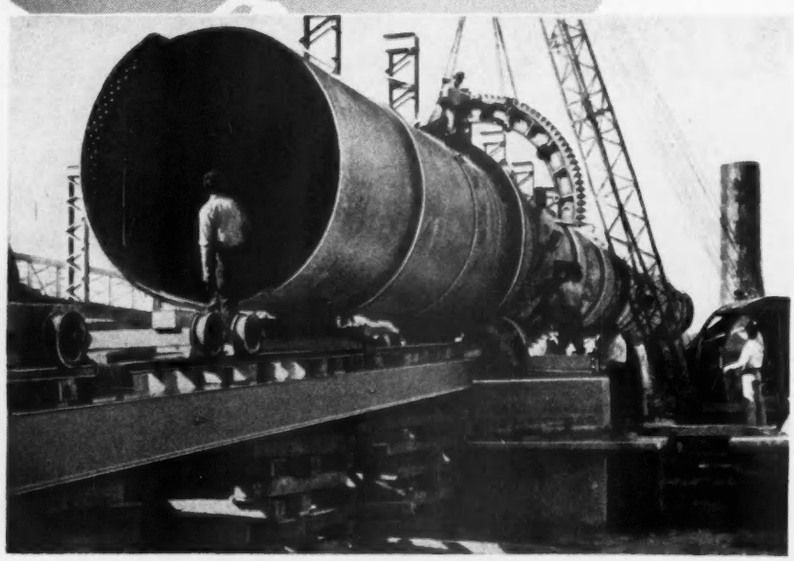

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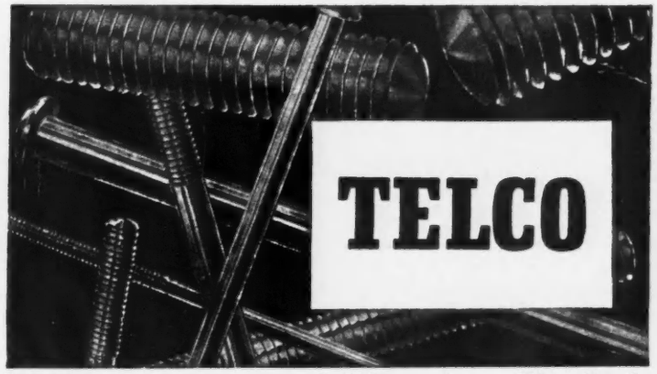

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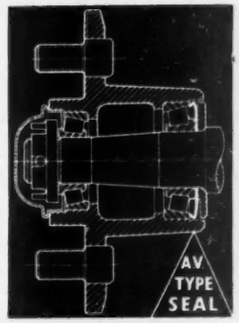

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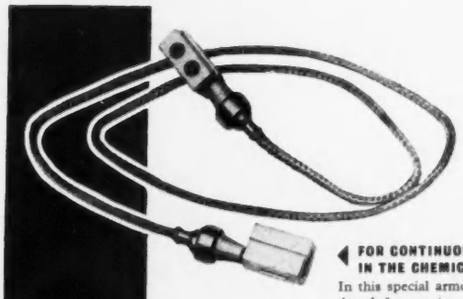
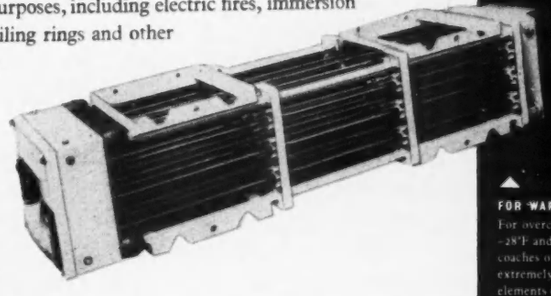
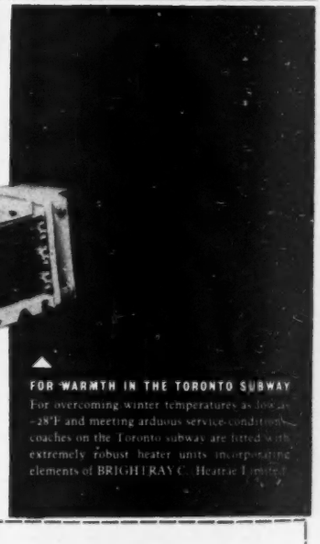


The reliability of Brightray materials is proved in exacting situations like these. The Brightray series includes suitable resistance alloys for most industrial and domestic purposes, including electric fires, immersion heaters, boiling rings and other appliances.



FOR CONTINUOUS SERVICE IN THE CHEMICAL INDUSTRY
In this special armoured heater produced for continuous processing in chemical equipment involving corrosive conditions, BRIGHTRAY C is used for the element winding to provide the long life and reliability needed. (Electrothermal Engineering Limited)



FOR WARMTH IN THE TORONTO SUBWAY
For overcoming winter temperatures as low as −28°F and meeting arduous service conditions, coaches on the Toronto subway are fitted with extremely robust heater units incorporating elements of BRIGHTRAY C. Heatrae Limited

BRIGHTRAY

NICKEL-CHROMIUM Electrical Resistance Alloys

BRIGHTRAY C for intermittent heating up to 1150°C . . . used in cookers, toasters, laundry irons, fires, soldering irons.

BRIGHTRAY B for elements working up to 950°C.

BRIGHTRAY S for continuous heating up to 1150°C . . . mainly for electric furnace elements.

BRIGHTRAY F for electric furnace elements operating in special atmospheres up to 1000°C.

BRIGHTRAY H for furnace elements in the range 1100°C to 1250°C (strip form only).

Produced in the form of Rod, Wire, Strip and Tape.

WILCO-WIGGIN THERMOMETALS in many grades for thermostatic devices controlling temperatures ranging from −75 to 540°C.

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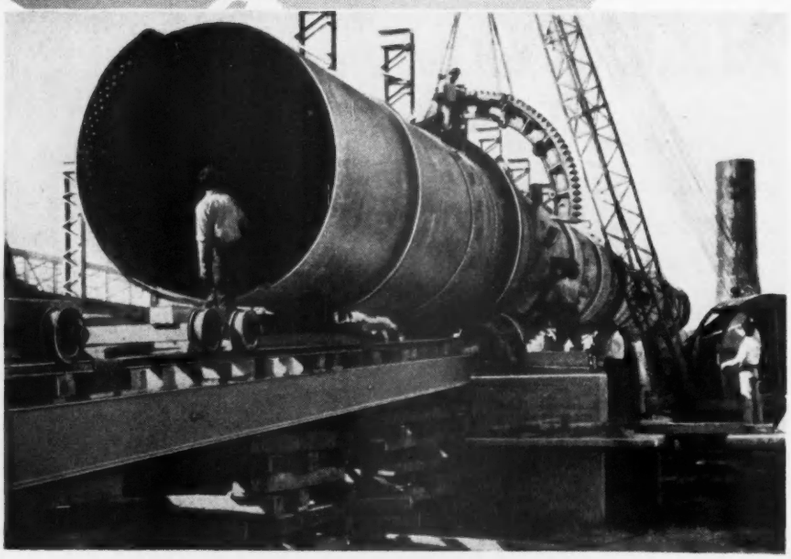

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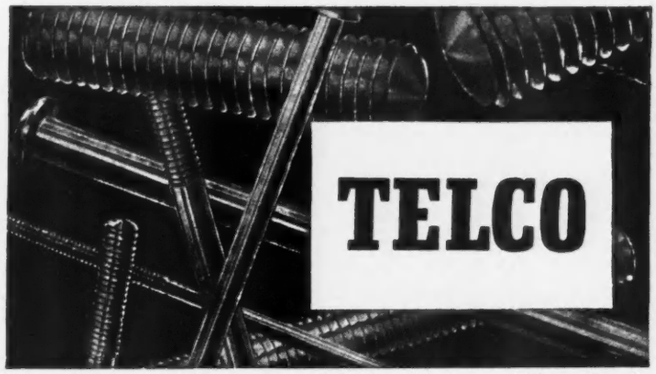

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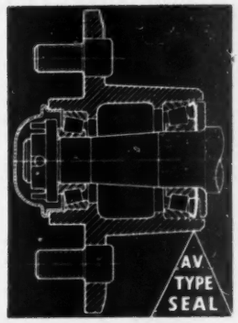

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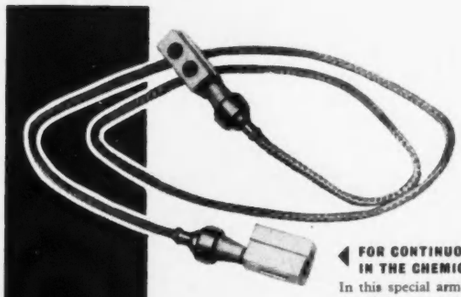

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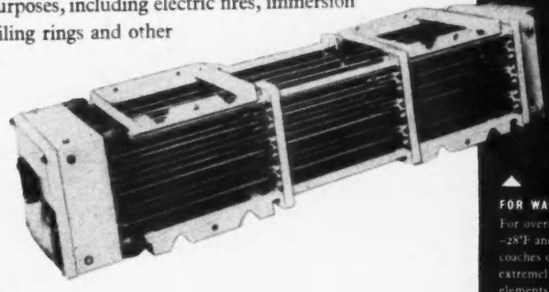

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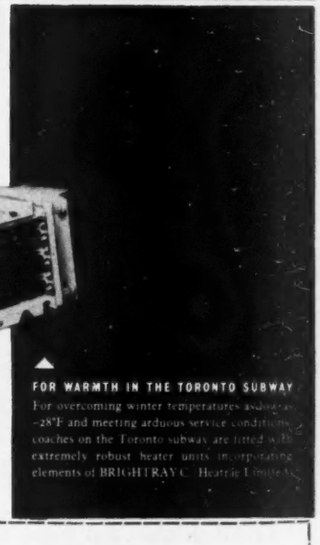

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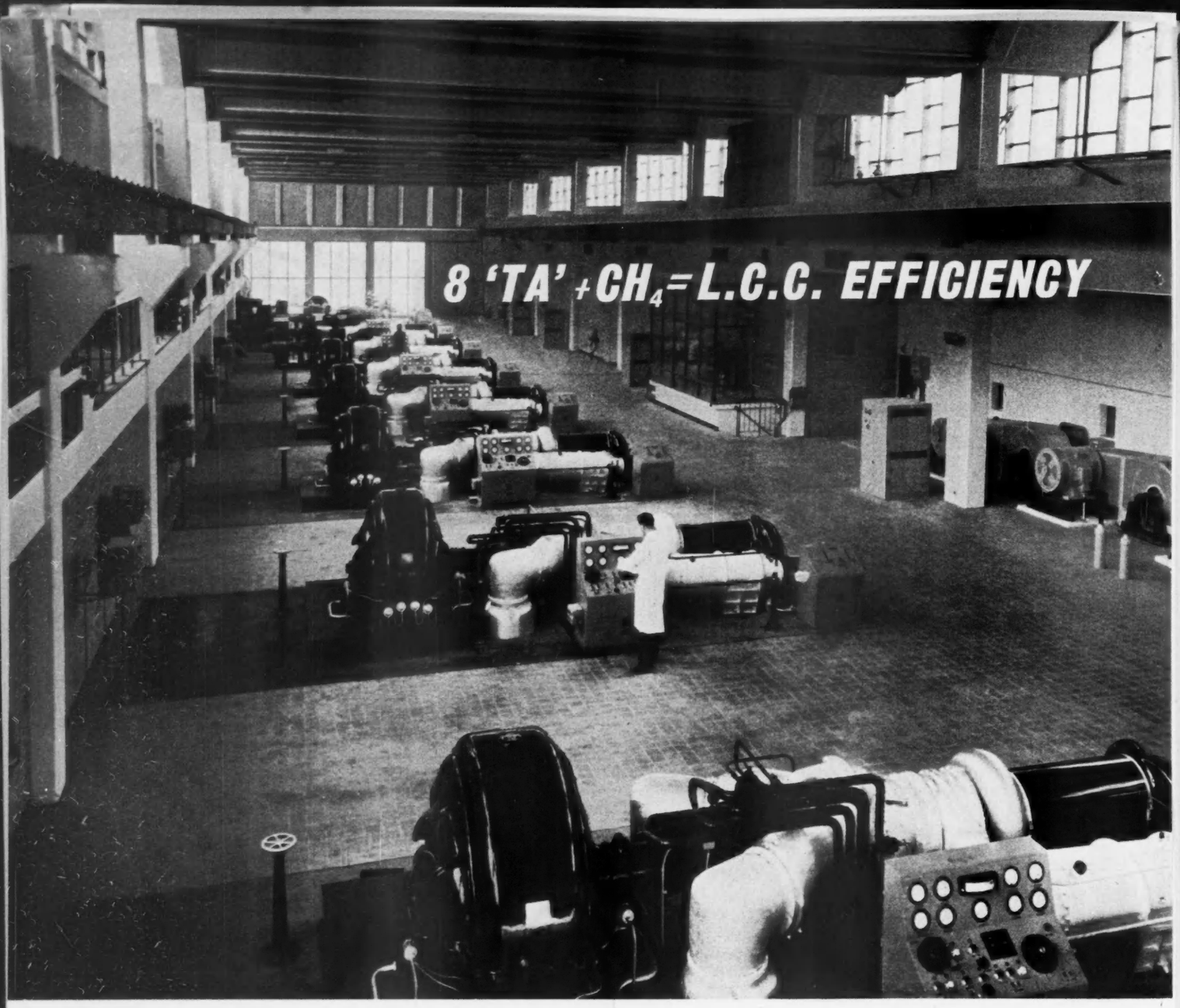

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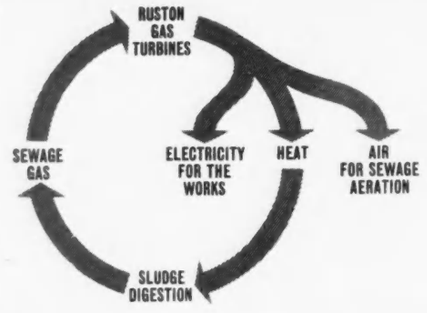

*Chief Engineer, London County Council: J. RAWLINSON ESQ., C.B.E., M.Eng., M.I.C.E., M.I.Mech.E.

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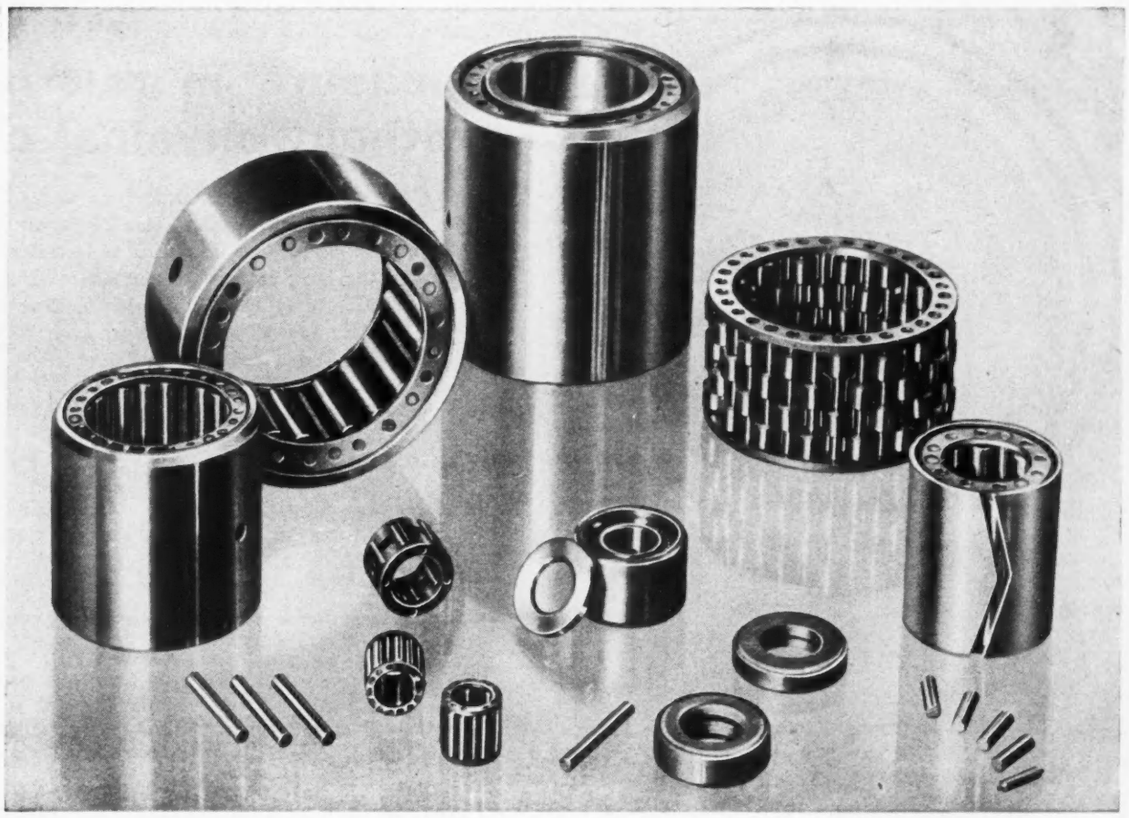
Send today for Comprehensive Catalogue



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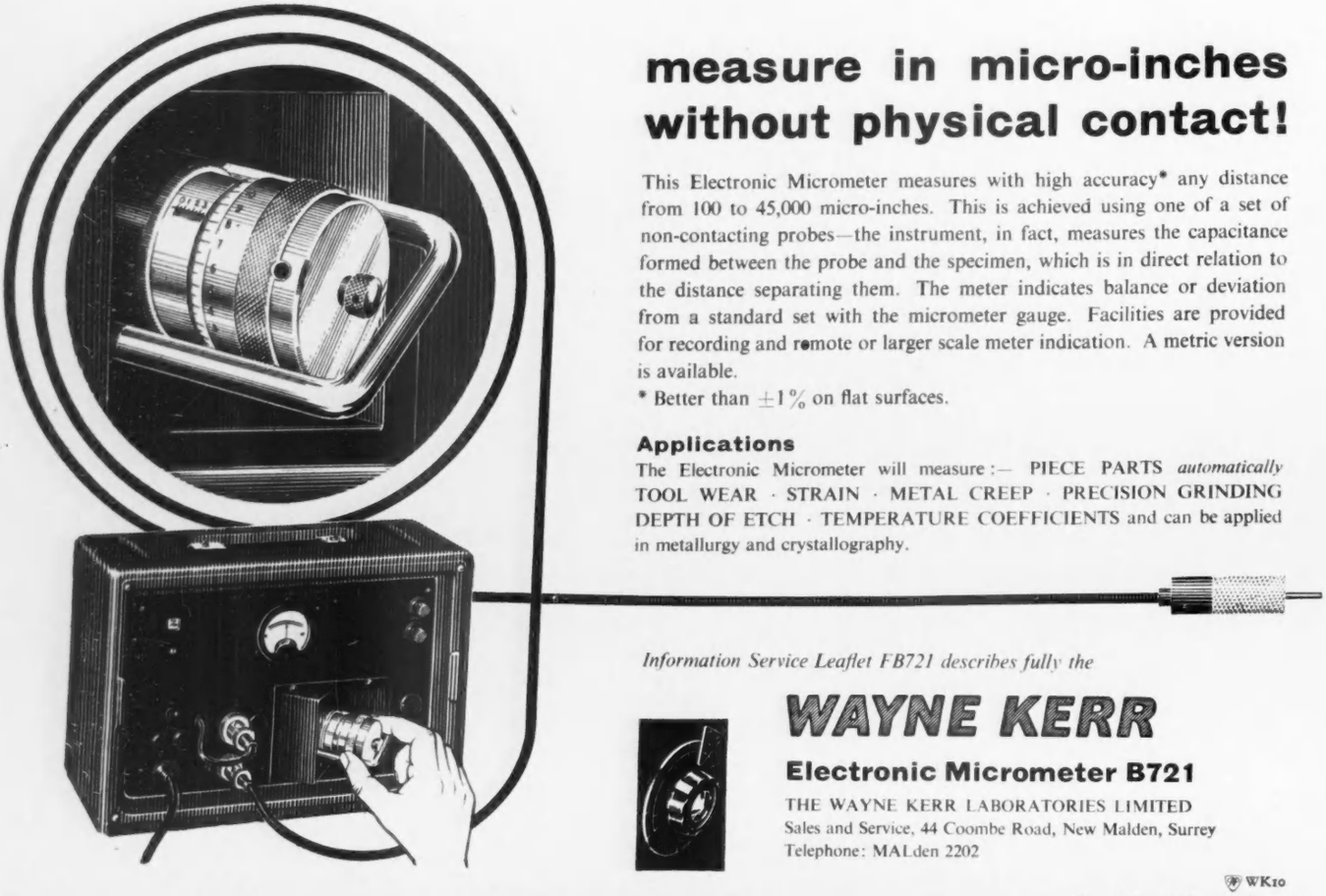

measure in micro-inches without physical contact!

This Electronic Micrometer measures with high accuracy* any distance from 100 to 45,000 micro-inches. This is achieved using one of a set of non-contacting probes—the instrument, in fact, measures the capacitance formed between the probe and the specimen, which is in direct relation to the distance separating them. The meter indicates balance or deviation from a standard set with the micrometer gauge. Facilities are provided for recording and remote or larger scale meter indication. A metric version is available.

* Better than ±1% on flat surfaces.

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Information Service Leaflet FB721 describes fully the

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When the Wallasey Ferry Undertaking required a new ferry vessel to supplement their existing fleet they specified Crossley engines for the propulsion machinery.

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Crossley machinery has helped to make the Wallasey Ferries one of the most efficient ferry fleets in the world.

With the introduction of exhaust gas turbo-charging the range of Crossley engines in powers up to 3200 b.h.p. per unit covers the needs of vessels both large and small.

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VACANCY FOR PROFESSOR OF CIVIL ENGINEERING

The University invites applications for appointment to a newly created CHAIR OF CIVIL ENGINEERING in the School of Civil Engineering at Sydney.

Salary will be £A3768 per annum.

The present professorial staff comprises the Head of the School, Professor C. H. Munro, an Associate Professor in Structures, and an Associate Professor in Hydraulics.

The successful applicant will be expected to take an important part in the administration and development of the School and to promote research and post-graduate study in his chosen field.

In due course, the School is expecting to move to new buildings which are at present being designed, and which should permit a large expansion in both its teaching and research activities.

Subject to satisfactory medical examination, the successful applicant will be eligible to join the Superannuation Fund which provides a pension of £A1638 per annum.

Professors are eligible for six months' study leave on full salary after three years of service, or twelve months after six years of service.

Subject to the consent of the Council of the University, professors may engage in a limited amount of higher consultative work.

The University reserves the right to fill the Chair by invitation.

With the approval of the University and its bankers, married men may be assisted by loans to purchase a home.

First-class ship fares to Sydney of appointee and family will be paid.

Four copies of applications, together with the names of three referees and a recent photograph, should be lodged with the Agent General for New South Wales, 56–57, Strand, London, W.C.2, and a copy forwarded by air mail in an envelope marked "University Appointment," to the Bursar, The University of New South Wales, Box 1, Post Office, Kensington, New South Wales, Australia, before 21st December, 1959. E7731

MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE

BRUNEL COLLEGE OF TECHNOLOGY, WOODLANDS AVENUE, ACTON, W.3

Applications are invited for the following posts :

(a) SENIOR LECTURER IN MECHANICAL ENGINEERING, to teach Diploma in Technology and Higher National Certificate classes and to supervise projects and tutoring scheme for Dip. Tech. students.

(b) LECTURER IN MECHANICAL ENGINEERING. Special interest in Mechanics of Fluids would be an advantage.

Candidates should have an Honours Degree and/or professional qualifications, preferably with teaching and industrial experience. Research and contact with industry encouraged.

Salary according to qualifications and experience, within the Burnham Technical Salary Scales, i.e. Senior Lecturer £1550 by £50 to £1750, plus London allowance £38–£51. Lecturer, £1370 by £35 to £1550, plus London allowance £38–£51.

Application forms from the Principal.

C. E. GURR, M.Sc., Ph.D.,
E7704 Secretary to the Education Committee.

BEDFORDSHIRE EDUCATION COMMITTEE

MANDER COLLEGE, BEDFORD

SENIOR LECTURER

Applications invited from University Graduates with industrial and teaching experience, for appointment as SENIOR LECTURER IN MECHANICAL ENGINEERING at Mander College, Bedford. Specialist subjects, Strength of Materials and Theory of Machines to H.N.C. standard.

Salary scale : £1550 by £50 to £1750. Provision made for appointment above the minimum in approved cases.

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T. S. LUCKING,
E7759 Director of Education.

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LECTURER IN MECHANICAL ENGINEERING

Applications are invited for the post of LECTURER IN MECHANICAL ENGINEERING. Applicants should possess good academic qualifications and have had industrial experience. Encouragement is given to undertake research and consulting work.

Salary scale : £1370 by £35 to £1550 per annum, commencing salary being determined by previous experience and qualifications. The post is pensionable.

Application forms and further information may be obtained from the Registrar. (In reply, please quote 18/C.) E7763

UNIVERSITY OF ADELAIDE

SENIOR LECTURER IN ELECTRICAL ENGINEERING

Applications are invited for the above appointment. Applicants should have good academic standing and industrial or laboratory experience in electrical machinery and automatic control.

Salary scale : £A2100–£A80–£A2500, with superannuation on the F.S.S.U. basis.

Copies of the general conditions of appointment of Senior Lecturers in the University may be had on application to the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1, or to the Registrar ; the Calendar of the University may be seen in the Library of any University which is a member of the A.U.B.C. ; housing help is available ; any further information desired will be supplied on request.

Applications in duplicate and giving the information listed in the general conditions of appointment, should reach the Registrar, The University of Adelaide, Adelaide, South Australia, not later than November 30, 1959. It is desirable that the successful candidate should be able to assume duty early in 1960. E7722

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

READER IN MECHANICAL ENGINEERING

Applications are invited for this post from well-qualified Engineers who are interested in pursuing research, of particular application to industry, in an atmosphere of academic freedom. The Reader will have a large measure of responsibility for the direction of his work, with the opportunity of making a major contribution to the development of the College.

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WEST FIFE AREA OF SCOTTISH DIVISION

FUEL AND POWER ENGINEER

FUEL AND POWER ENGINEER required by National Coal Board in the West Fife Area of Scottish Division. Salary, according to qualifications and experience, within the range £1050 to £1600 per annum. Candidates should have had experience with cost and performance control of industrial steam raising and power plant ; be capable of operating a control centre and of analysing routine returns for a group of collieries generating and using steam, electricity and compressed air. The successful candidate will be responsible to the Area Mechanical Engineer for the introduction of power utilisation control systems within the Area and he will be expected to prepare reports for the Area Management and to make recommendations. Applicants should have the Higher National Certificate in Mechanical and/or Electrical Engineering, practical experience in plant operation and, preferably, a Certificate in Fuel Technology.

Applications, stating age, education, qualifications, experience, present post and salary, to Staff Department, National Coal Board, 3, Eglinton Crescent, Edinburgh, 12. E7683

PUBLIC APPOINTMENTS

COUNTY BOROUGH OF BRIGHTON EDUCATION COMMITTEE

BRIGHTON TECHNICAL COLLEGE

Principal : G. E. WATTS, M.A., Ph.D. (Cantab) B.Sc. (Lond.), F.R.I.C.

(REVISED ADVERTISEMENT)

MECHANICAL ENGINEERING DEPARTMENT

Required as soon as possible :

MECHANICAL ENGINEERING DEPARTMENT LECTURER or ASSISTANT (Grade B) IN MECHANICAL ENGINEERING, prepared to teach Engineering Metallurgy and at least one other mechanical engineering subject, with Degree in Engineering or Metallurgy or Corporate Membership of appropriate professional Institution.

Salary scales :

Lecturers (men) : £1370 by £35 (4) plus £40 to £1550.

Assistants, Grade B (men) : £700 by £27 10s. (15) plus £37 10s., to £1150, plus graduate and training allowances if appropriate.

Increments may be allowed in each scale for approved industrial, professional or research experience.

Further particulars and application forms from the undersigned, to be returned to the Principal, Brighton Technical College, Brighton, 7, within 14 days.

W. G. STONE,
Director of Education.
54, Old Steine,
Brighton. E7764

BRITISH TRANSPORT DOCKS

SOUTH WALES DOCKS

ENGINEERING ASSISTANT

British Transport Docks invite applications for three positions of ENGINEERING ASSISTANT, South Wales Docks. Candidates should have had experience in the preparation of schemes and estimates for general civil engineering construction, with some experience on works.

The starting salary for two of the posts will be £833 per annum, and preference will be given to candidates who hold an Engineering Degree and/or are Graduates of the Institution of Civil Engineers.

The commencing salary for the other post will be £943 per annum and applicants should also have had experience in the construction and maintenance of civil engineering works, preferably with some knowledge of maritime structures ; a knowledge of building construction will be an advantage. Corporate Membership of the Institution of Civil Engineers desirable and would attract, subject to experience, a higher salary range.

Travel facilities, superannuation scheme, &c.

Applications, giving age, experience and qualifications, to the Chief Docks Manager, British Transport Docks, Pierhead Buildings, Cardiff, to arrive not later than Friday, 6th November, 1959. E7736

PRISON COMMISSION

H.M. BORSTAL, PORTLAND, DORSET

CIVILIAN INSTRUCTIONAL OFFICER GRADE III (ENGINEERING FITTER MACHINIST)

CIVILIAN INSTRUCTIONAL OFFICER, GRADE III (Engineering Fitter Machinist) required at H.M. Borstal, Portland, Dorset.

Age at least 30 on 27th November, 1959.

Qualifications : Full apprenticeship, plus at least five years' industrial experience. Must be able to give theoretical and practial instruction to inmates. City and Guilds Certificate or equivalent qualification desirable.

Salary scale : £775 to £900 ; 44-hour week, generous paid holidays. Pensionable appointment considered after a period of satisfactory service.

Write Prison Commission, R.241-245, Horseferry House, Dean Ryle Street, London, S.W.1, for application form.

Closing date : 13th November, 1959. E7757

PUBLIC APPOINTMENTS

METROPOLITAN BOROUGH OF WANDSWORTH

ASSISTANT ENGINEERS

ENGINEERING ASSISTANTS

Applications invited for :—

(a) SENIOR ASSISTANT ENGINEER, A.P.T. V, £1250–£1405.

(b) SENIOR ASSISTANT ENGINEER, A.P.T. IV, £1095–£1250.

(c) FOUR ASSISTANT ENGINEERS, Special Grade, £815–£1100.

(d) TWO ENGINEERING ASSISTANTS, A.P.T. I, £640–£795.

Commencing salary according to qualifications and experience.

Applicants for (a) must be Assoc. Members of the I.C.E. and I.Mun.E., with considerable experience in design and construction of sewers. Applicants for (b) and (c) must have passed the final examination of one of those professional bodies, or possess a Degree in Engineering, and have at least five years' experience including training. Applicants for (d) must be neat draughtsmen with experience in civil engineering works.

Forms from Borough Engineer, returnable by 16th November.

J. NOEL MARTIN,
Town Clerk.
Municipal Buildings,
Wandsworth, S.W.18. E7767

CIVIL SERVICE COMMISSION

CIVIL, STRUCTURAL AND PUBLIC HEALTH ENGINEERS

Pensionable posts for men and women at least 25 and under 35 on 1st January, 1959 (extension for regular Forces service, Overseas Civil Service, established civil service and temporary Government service as Civil, Structural or Public Health Engineer). Candidates must have achieved Corporate Membership of an appropriate professional Institution or have passed examinations necessary for attaining such membership. Some posts require qualifications in certain subjects. Starting salary (men, London) from £830 to £1125, according to age. Scale maximum (London) £1300. Promotion prospects.

Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S64–66. E7713

ARCHWAY GROUP HOSPITAL MANAGEMENT COMMITTEE

WHITTINGTON HOSPITAL

ASSISTANT ENGINEERS

ASSISTANT ENGINEERS required at Whittington Hospital, N.19. Applicants over 25 years of age preferred, who should have completed practical training in mechanical engineering. Ordinary National Certificate for Mechanical Engineering or equivalent an advantage. Salary scale : £545–£670 per annum, plus £30 London Weighting at 26 or over. Successful candidate will be required to reside within reasonable distance of hospital. Department may be visited by direct appointment with Hospital Secretary, ARC 3070, Extension 254.

Application forms obtainable from and returnable to Group Secretary, 46, Cholmeley Park, N.6, by 14th November, 1959. E7741

CIVIL SERVICE COMMISSION

MECHANICAL, ELECTRICAL AND HEATING AND VENTILATING ENGINEERING DRAUGHTSMEN

Pensionable posts for men and women aged at least 20 on 1st June, 1959, with at least 3 years' training, including adequate practical experience with appropriate technical study. Appropriate O.N.C. is essential, and at least one year must have been spent in full-time drawing-office work. Men's starting salary (London) £542 10s. (20) to £783 (28 or over). Scale maximum £900. Promotion prospects.

Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S68–69/59. E7714

PUBLIC APPOINTMENTS

WEY VALLEY WATER COMPANY

CIVIL ENGINEERING ASSISTANT

CIVIL ENGINEERING ASSISTANT, commencing salary £750–£850 per annum, with annual increments, plus car allowance.

Applications are invited for the above appointment on the permanent staff of the Wey Valley Water Company.

Qualifications : Applicants must have been trained as Civil Engineers and have either passed Parts I and II of the Institution of Civil Engineers' examination or hold a University Degree. Preference will be given to those who have had experience in the office of a Water Engineer.

The applicant should hold a licence to drive a car.

The appointment is permanent and pensionable.

Applications, stating age, qualifications, present position and salary, education, training and experience, should be sent to the Engineer and Works' Manager, Wey Valley Water Company, 3, Downing Street, Farnham, Surrey, not later than 25th November, 1959. E7738

PUBLIC APPOINTMENTS

SEVENOAKS AND TONBRIDGE WATER COMPANY

WATER ENGINEER

Applications are invited from duly qualified WATER ENGINEERS for the above appointment. Salary according to age and experience.

Candidates must possess the requisite experience in the design, construction and maintenance of water works and have the necessary knowledge of the practice and administration of water undertakings, including distribution.

The successful candidate will be provided with a car for use in connection with the business of the undertaking and housing accommodation will be available.

The post will be superannuable.

Applications, stating age, qualifications, experience and salary required, together with names and addresses of three persons to whom reference can be made, should be forwarded to : the Secretary, Sevenoaks and Tonbridge Water Company, Oak Lane, Sevenoaks, Kent. E2604

PHYSICISTS, CHEMISTS, ENGINEERS, MATHEMATICIANS

required in Research and Development Establishments

in **MINISTRY OF AVIATION**

mainly in **Southern England.**

Appointments in Grades of :

(*a*) Senior Scientific Officer (£1166–£1380).

(*b*) Scientific Officer (£615–£1090).

Starting salary according to experience.

Superannuation under F.S.S.U.

GOOD PROMOTION PROSPECTS

1st or 2nd Class Honours Degree or equivalent required, and for S.S.O. at least 3 years' post-graduate research experience.

FORMS from M.L.N.S. Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting A.438/9A/BFD.

E7743

NATIONAL RESEARCH COUNCIL

ENGINEER IN THERMODYNAMICS

National Research Council requires an ENGINEER to work in Thermodynamics.

Duties : To undertake theoretical and experimental studies of thermodynamic problems, especially cryogenic heat transfer in an Environmental Research Laboratory.

Education : Graduate or post-graduate with Honours from a recognised University in Engineering Physics, Physics or Mechanical Engineering. A thorough knowledge of thermodynamics, including cryogenics, is required.

Experience : A minimum of four years is desirable, some of which should have been in a research laboratory.

Salary : Up to $9000, depending on qualifications.

Apply to the Employment Office, National Research Council, Sussex Drive, Ottawa 2, Canada, giving full details of education and experience. In reply, please quote ME-4. E7739

TENDERS

REPUBLIC OF SUDAN

SUDAN RAILWAYS

STEEL BRIDGE OVER THE RIVER LOL

TENDERS are invited for the FABRICATION, SUPPLY and SHIPMENT of FIVE IDENTICAL HIGH TENSILE STEEL SPANS for the Bridge over the River Lol, to carry single-line rail traffic ; the span between centres of bearings is to be 108 feet.

All five spans must reach Port Sudan by 31st July, 1960.

Recognised steel bridge fabricators wishing to Tender can inspect the contract documents at the offices of the Consulting Engineers, Messrs. Coode and Partners, Abbey House, 2/8 Victoria Street, London, S.W.1, and from whom the contract documents will be available shortly on payment of the sum of £25.

Tenders for the bridge must be submitted in duplicate to the General Manager, Sudan Railways, c/o Messrs. Coode and Partners. E7733

FYLDE WATER BOARD

CONTRACT NO. 82

GARSTANG BOREHOLE SCHEME—WELDED STEEL AIR RECEIVERS

TENDERS are invited for 2 WELDED STEEL AIR RECEIVERS, approximately 7–9ft. dia. by 24–40ft. long, 170 lb./sq. inch working pressure.

Further particulars and Tender documents from Engineer to the Board, Sefton Street, Blackpool. Tenders to be submitted by November 16, 1959. E7710

TENDERS

INDIA SUPPLY MISSION, 2536, MASSACHUSETTS AVENUE, N.W., WASHINGTON

TENDER ENQUIRY NO. S.E.110

The Office of India Supply Mission, 2536, Massachusetts Avenue, N.W., Washington, 8, D.C., United States of America, invites TENDERS for the following :

TENDER ENQUIRY No. S.E. 110

Four Nos. 180,000 lb. per hour or Two Nos. 325,000 lb. per hour WATERTUBE BOILERS for Amarkantak Thermal Power Station. Complete with ancillary equipment and suitable for burning pulverised coal.

Specifications, &c., relative to the above specification, can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost £1 15s. 8d. per tender. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, 8, D.C., United States of America, so as to reach them by 5th January, 1960.

Specimen copy of the above enquiry can be seen at India Store Department, Bromyard Avenue, Acton, W.3, under the following reference : S.3609/59/ENG.2. E7753

MADRAS PORT TRUST, MADRAS, INDIA

TENDER ENQUIRY NO. D.28768/59/EP

The Office of the Chief Engineer, Madras Port Trust, Madras, India, invites TENDERS for the following :

TENDER ENQUIRY NO. D.28768/59/EP

Eleven Nos. 3-ton WHARF CRANES for General Cargo Handling.

Specifications, drawings, &c., relative to the above can only be obtained from The Deputy Chief Accounts Officer (Engineering), Chief Engineer's Office, Madras Port Trust, Madras, India, on payment of two pounds twelve shillings and sixpence per set which is not refundable. Tenders are to be returned direct to The Chief Engineer's Office (at C Warehouse), Madras Port Trust, so as to reach there not later than 2.30 p.m. on 29th December, 1959.

Specimen copy of the above specification is available for examination at India Store Department, Bromyard Avenue, Acton, under reference S.3689/59/ENG.2. E7754

CITY OF LIVERPOOL

ECONOMIC BOILER

TENDERS invited for the SUPPLY and INSTALLATION of ONE OIL-FIRED ECONOMIC BOILER.

Details and Tender form from the Baths Manager and Engineer, 62, Fontenoy Street, Liverpool, 3.

Tenders returnable by 16th November, 1959.

(J.5894)b. THOMAS ALKER,
E7768 Town Clerk

TENDERS

N.A.T.O. COMMON INFRASTRUCTURE

SLICE VII

NAVAL BASE INSTALLATIONS

Final notice is hereby given that International Competitive BIDS will be invited on or about 3rd February, 1960, for the construction of a small P.O.L. STORAGE DEPOT at Rosneath in the Dumbartonshire area of Scotland.

(2) A separate final notice will be issued in respect of applications to Bid for the Electrical and Mechanical Installation work, which will be carried out as sub-contracts within the above main contract. Enquiries regarding these sub-contracts should be withheld pending the issue of final notices covering this work.

(3) The approximate total value of the contract is £250,000 and the work to be carried out comprises the construction of semi-buried storage tanks in steel or prestressed concrete and associated pipe works, a combined pump house and administration building, together with the provision of the usual services.

(4) The construction of the jetty facilities associated with this depot forms the subject of a separate contract, which has already been awarded.

(5) It should be noted that the importation of labour from sources outside the United Kingdom may be subject to restriction, and that permission could in any case only be granted on an undertaking that the contractor would pay rates of wages and observe hours and conditions of labour not less favourable than those established for U.K. labour for the trade or industry in the same area.

(6) The closing date for the receipt of Bids will be 13th April, 1960.

(7) Firms wishing to be invited to Bid must formally notify their desire by application to the address below by 30th December, 1959.

(8) Within one week of the closing date for receipt of applications to Bid, firms wishing to be invited must forward the following information :—

(i) Statement of financial resources and evidence of financial stability.

(ii) Details of recent major contracts completed for work of a comparable nature, including an indication of the value of each.

(9) Enquiries regarding Bidding should be addressed to :—

Civil Engineer-in-Chief,
Admiralty,
Chamberlain Way,
Pinner,
Middlesex,
England,

and quoting reference C.E. in C./INFRA/8A. E7760

COQUET WATER BOARD

FILTRATION WORKS AND PUMPING STATION—WARKWORTH

CONTRACT NO. 10

TENDERS are invited for the SUPPLY to and DELIVERY and ERECTION at the site of all or any of the following pumping equipment :

(i) Two (2) Vertical Spindle, Borehole Type Pumps (exclusive of motors and other electrical equipment) of capacity ranging between 3470 gallons per minute, 345 feet head and 6940 gallons per minute, 392 feet head.

(ii) Three (3) Vertical Spindle, Borehole Type Pumps (exclusive of motors and other electrical equipment) of capacity ranging between 500 gallons per minute, 321 feet head and 1000 gallons per minute, 343 feet head.

(iii) Three (3) Submersible Pumps (inclusive of motors but exclusive of other electrical equipment) of 4164 gallons per minute, 120 feet head capacity.

(iv) Two (2) Vertical Spindle, Borehole Type Pumps (exclusive of motors and other electrical equipment) of 450C gallons per minute, 38 feet head capacity.

(v) Two (2) Vertical Spindle Borehole Type Pumps (exclusive of motors and other electrical equipment) of 433 gallons per minute, 37 feet head capacity.

(vi) Two (2) Vertical Spindle, Wet Sump, Unchokable Pumps (exclusive of motors and other electrical equipment) of 345 gallons per minute, 44 feet head capacity.

(vii) Two (2) Air Blowers of Roots Positive Displacement Type (exclusive of motors and other electrical equipment) of 860 cubic feet per minute, 5 pounds per square inch capacity.

Specifications and drawings may be obtained on application to Mr. S. G. Barrett, M.I.C.E., Engineer and Manager to the Coquet Water Board, P.O. Box 104, Pilgrim Street, Newcastle upon Tyne, 1.

Tenders to be returned in envelope provided, to the undersigned, not later than 10 a.m. on 21st December, 1959.

F. G. EGNER,
Clerk and Solicitor to the Board.
14, Northumberland Square,
North Shields. E7756

COUNTY COUNCIL OF ESSEX

SOUTH EAST ESSEX TECHNICAL COLLEGE, BARKING

BOILER HOUSE WORKS AND OIL FIRING

Contractors wishing to submit a firm price TENDER for the above should forward their names, from which a panel will be chosen and provided with Tender documents.

The work consists of ALTERATIONS to BOILER EQUIPMENT and INSTALLATION of OIL-FIRING EQUIPMENT, at an estimated value of £3000.

Applications to reach the undersigned not later than 7th November, 1959.

H. CONOLLY, C.B.E., F.R.I.B.A.,
County Architect.
County Hall,
Chelmsford. E7765

EDUCATIONAL

UNIVERSITY OF LONDON KING'S COLLEGE

STUDENTSHIP

UNIVERSITY OF LONDON KING'S COLLEGE offers a STUDENTSHIP of £800 a year, made available by Joseph Lucas, Ltd., for research into the initiation of explosions in gases, vapours and powder clouds, or into the mixing of powdered materials. Applicants should have a good Honours Degree in some branch of Engineering, Physics or Chemistry and be prepared to work for a Higher Degree.

Particulars and application forms from the Registrar, King's College, London, Strand, W.C.2, whom completed forms must reach by November 20th, 1959. E7719 E

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

A DRAUGHTSMAN

is required by Petfoods Limited for a vacancy in the Development Engineering Department of their modern, high-speed canning factory at Melton Mowbray.

This is an important position which arises because of promotion within the Company. It will involve challenging and absorbing work, much of which is project work in a very real sense. For this, experience in the field of power supply and the control wiring of industrial equipment will be especially valuable.

The successful applicant, who should have a H.N.C. in Mechanical Engineering, will receive a starting salary not below £1000 per annum, with prospects of earning substantially more.

There are non-contributory sickness benefit, life assurance and pension schemes, and the Company will assist in the housing problem.

Please address applications, giving full information of age, qualifications and experience, to the

Personnel and Safety Officer,
PETFOODS LIMITED,
Melton Mowbray, Leics.

E7740 A

APPLEBY-FRODINGHAM STEEL COMPANY, SCUNTHORPE, LINCOLNSHIRE, invite applications for posts as SENIOR and JUNIOR DRAUGHTSMEN for general engineering work. Experience in design and detail of plant for iron and steel works would be an advantage. Permanent situations with good prospects for men with initiative and ability. Staff pension scheme is in operation and welfare facilities are available.—Apply, stating age and giving full details of previous experience, and technical qualifications, to the Employment Officer, Appleby-Frodingham Steel Co., Scunthorpe, Lincs. E2611 A

APPLICATIONS are invited for the posts of SENIOR JIG AND TOOL DRAUGHTSMAN, SENIOR MACHINE TOOL DRAUGHTSMAN, and PRODUCTION ENGINEERS, with experience in machining light alloys, for Drawing Office in Southern England.—Write, stating age, details of experience, qualifications and salary required to BOX No. E7748, "The Engineer." A

APPLICATIONS are invited from ENGINEERS for responsible posts on research and development of PRODUCTION PROCESSES for the engineering industry. Excellent opportunities for those with ability and initiative. Candidates should have an engineering degree, Higher National Certificate, or equivalent qualification. Excellent working conditions in pleasant surroundings. Superannuation scheme. Removal expenses paid.—Send full details including age, qualifications, experience and present salary in confidence to BOX No. E7655, "The Engineer." A

APPLICATIONS ENGINEERS REQUIRED for Technical Department of rapidly growing Lubrication Equipment Company serving heavy, particularly iron and steel, industries. Good prospects for keen engineers prepared to work hard. Layout or D.O. experience or German language an advantage. Location, London, N.18, (Edmonton) —Reply in confidence to Managing Director, Centralube, Ltd., Park Royal Road, London, N.W.10. E2606 A

ASSISTANT CHIEF DRAUGHTSMAN required by expanding Company in Surrey approximately 25 minutes from Waterloo. Successful applicant should be experienced in the design of small mechanisms, &c., be a good disciplinarian, and in view of the specialised nature of the product will be expected to make his career with the Company. Minimum qualification of H.N.C., but men with experience and a sound background who are not so qualified will be considered.—BOX No. E169, "The Engineer." A

ASSISTANT METALLURGIST required for company producing special steels and having expanding interests. Minimum qualification A.Met. or A.I.M. Age up to 35 years. Experience of stainless heat and creep resisting steels desirable.—Apply, giving qualifications, experience and salary required to the Secretary, Samuel Osborn and Co., Ltd., P.O. Box No. 1, Sheffield. E7747 A

CONSULTING CIVIL ENGINEERS, Westminster, require a fully qualified STRUCTURAL ENGINEER with wide experience, for position as CHIEF DESIGNER in reinforced and prestressed concrete and structural steelwork (including bridges). Prospects of partnership interest in firm. Write in confidence, stating age and full details of experience and qualifications.—BOX No. E2594, "The Engineer." A

Classified Advts. continued on page 148

SITUATIONS VACANT

ASSISTANT WORKS SUPERINTENDENT

now required by large Industrial Group at Factories situated in Northern England.

The immediate position envisaged is one of understudy to present Superintendent.

The position, which is superannuable, holds future scope for man of ability, with experience of plant maintenance and upkeep, coupled with ability to control staff.

Commencing salary will be not less than £1500 per year.

Applications, which will be treated in strict confidence, are invited from candidates age 30 to 38. Send full particulars of education, age, experience, and present earnings, &c., to BOX No. E7595, "The Engineer."

A

DESIGN ENGINEER required by firm of Hydraulic and Heavy Mechanical Engineers. Canteen facilities and Superannuation Scheme.—Write, giving details of age, experience and salary required to Chief Engineer, Henry Berry and Co., Ltd., Croydon Works, Leeds, 10. E2584 A

DESIGNER-DRAUGHTSMEN

An Engineering firm of repute in the Eastern Counties has vacancies for two experienced DESIGNER-DRAUGHTSMEN, aged 25–36. Minimum qualification H.N.C. or equivalent, one appointment being for a Graduate or Associate Member Inst.Mech.E., to assume responsible position after period of training.

Candidates must prove ability to produce sound designs and to accept responsibility for mechanical and structural projects of unusual as well as orthodox nature. Experience of crane type structures and/or medium/heavy contractor's plant an advantage.

Attractive salaries to suitable applicants. There is a contributory pension scheme and good canteen facilities.

Write in confidence giving full information about qualifications, experience and salary required quoting Ref. No. K.5974 to :

WRIGHT ATKINSON, LTD.,
Employment Consultants,
70, Queen Victoria Street,
London, E.C.4.

E7694 A

DETAILER AND DESIGNER with originality and ingenuity required by expanding firm making up-to-date mechanical aids for the Building Industry. Write, giving full details of experience and qualifications.—BOX No. E2613, "The Engineer." A

ELECTRICAL ENGINEER, Graduate or equivalent, required by the Research Department of a large Mechanical Engineering Company in East Midlands, with interests in the field of automation. The Company employs over 4000. The position offers good prospects for a man of initiative. Starting salary according to qualifications and experience.

Housing difficulty recognised.

Five-day week. Pension Scheme. Canteen and Sports Club.

Apply, stating age, qualifications and experience.—BOX No. E7686, "The Engineer." A

ESSO PETROLEUM COMPANY LIMITED have a vacancy in London for a MECHANICAL ENGINEER. The work covers estimating, preparation of contract documents, supervision of drawing and responsibility for construction. Contracts include a wide range of maintenance and new construction with particular emphasis on petroleum product storage, pipework and pumps.

Applicant should preferably be A.M.I.Mech.E. and had experience in oil or chemical industries, with particular reference to piping and pumping problems.

The position offers considerable scope for promotion and carries with it excellent employee benefits, including a PENSION PLAN which is amongst the best and most comprehensive of such schemes.

Application, giving brief details of career, should be made to the Employee Relations Manager, Esso Petroleum Co., Ltd., Porchester Gardens, Queensway, London, W.2. E7761 A

EXPERIENCED DRAUGHTSMAN required, used to conveying and material handling practice, must be capable of both design and detail work. Good salary paid to right applicant.—Write in first instance, stating age, salary required and experience, to Maxim Conveyors (England), Ltd., Crabtree Manorway, Belvedere, Kent. E2600 A

GOOD YOUNG FOREMAN ELECTRICIAN preferably single, required for West Africa. Able to supervise installation contracts and control labour. Good terms, conditions and prospects. Apply, stating age, qualifications, pay required, &c.—BOX No. E2592, "The Engineer." A

INSURANCE COMPANY has vacancy for ENGINEER SURVEYOR for inspection of Boiler and Pressure Plant. Must have 1st Class M.O.T. Certificate with Steam Endorsement or equivalent. Will be necessary to reside in or near Shrewsbury. Commencing salary £800, rising to £1100 (E.S.A. Scale). Car provided if necessary.—Write, BOX E632 L.P.E., Romano House, 399/401, Strand, London, W.C.2. E7766 A

MUNICIPAL MUTUAL INSURANCE LTD. has vacancies for MECHANICAL ENGINEER SURVEYORS in London, Birmingham and Bradford. Posts are pensionable and permanent to satisfactory candidates, who should have served an apprenticeship and have sound practical and theoretical knowledge. Technical qualifications.: First Class Ministry of Transport Certificate. Also CRANE AND LIFTING TACKLE SURVEYOR with Higher National Certificate, in London. Salary : £800, rising to £1100 per annum.—Apply in own handwriting, marking the envelope "Application Engineer Surveyor" and "Private and Confidential," to the Chief Engineer, 22, Old Queen Street, Westminster, S.W.1. E7746 A

INSTRUMENTATION ENGINEER

British Nylon Spinners invite applications for a graduate in Mechanical or Electrical Engineering to fill a vacancy in their Head Office.

Candidates, between 28–35 years of age, should have had experience in the investigation, design and application of industrial instrumentation, including pneumatic and electrical control gear.

This appointment offers a progressive and satisfying career to a man who is keen to apply his knowledge to design and installation problems and to follow a project through to its completion. Prospects are good.

A contributory pension scheme is in operation, houses may be rented and removal expenses assisted.

Selected applicants will be invited to visit the Company, which is attractively situated, for a personal discussion.

Applications, quoting Ref. 2/E/17, should be made to

The Personnel Manager,
British Nylon Spinners, Limited,
Pontypool, Monmouthshire.

E7730 A

MEDIUM-SIZE FOOD FACTORY in Hull requires services of experienced and well-qualified ENGINEER. A successful applicant would be required to serve as Assistant to the Chief Engineer but should be able to take over full control in his absence. It is essential to have previous experience and successful control of labour ; a practical as well as theoretical knowledge of steam raising and refrigeration is also required and drawing-office experience would be an advantage. Please state details of experience, particularly in the above fields, together with age and salary required.—BOX No. E7671, "The Engineer." A

NIGERIAN ENGINEERING SUPERVISOR required for care and maintenance of Palm Oil Bulking Installation in West Africa. Qualifications not less than O.N.C. in Mechanical Engineering and preferably H.N.C. Practical knowledge of Boiler Plants, Steam and I.C. Engines, Centrifuges and Electrical Installation an advantage. Advertiser anticipates required experience will not have been achieved by anyone under 28. Salary dependent on qualifications and experience but not less than £650 per annum. The position is permanent and pensionable. Please apply.—BOX No. E7682, "The Engineer." A

PROJECT AND DEVELOPMENT ENGINEER is required to join a team responsible for the design and construction of new plant for use in the manufacture of seamless tube. An Engineer aged 26–30 years with a sound, practical training and preferably a Degree in Engineering is required. The work will include the planning, implementation and analysis of the necessary trials, followed by the application of the results so obtained to the design of plant up to the stage where production equipment can be installed. A man capable of working on his own initiative is required.—Applications, giving full details of age, qualifications and experience, together with salary required, should be addressed to the Chief Engineer, Tubes Limited, Eagle Works, Kirby Muxloe, Nr. Leicester. E7744 A

RESIDENT ENGINEER required by major contracting company for construction supervision of new Oil Refinery and Chemical Plants. Must be a good administrator and able to assume complete control of civil and mechanical engineering site organisation. The successful applicant will deal with clients' jobs of £5,000,000 and over. Salary up to £3000 per annum, according to experience and qualifications. Please write, in confidence, giving full details of past employers and contracts carried out.—BOX No. E7737, "The Engineer." A

SALES REPRESENTATIVE with technical knowledge required by leading British Company operating Middle East. Applicants should have experience and general technical knowledge in one or more of following trades : Transformers and Generators ; Oil Field Equipment. Various other engineering products. Position offers good prospects in rapidly developing market. Work interesting and varied. Only person with knowledge and experience of technical sales engineering products should apply.—BOX No. E2605, "The Engineer." A

SENIOR DEVELOPMENT/ TUNNELLING ENGINEER

A vacancy has arisen for the HEAD of THE TUNNELLING BRANCH in the National Coal Board's Central Engineering Establishment, Nr. Burton upon Trent. This Branch is responsible for the development of equipment and services used in driving main roadways underground.

The successful candidate will be responsible for feasability studies, the assessment and planning of projects throughout all stages of development and the supervision and technical control of the work of his Branch, including the co-ordination of those services provided by other sections of the Establishment. He will be responsible for negotiations with contractrso working on his projects; a so for supervision of trials of his equipment, both on test sites and underground.

The successful candidate must be well qualified and experienced to discharge the exacting duties of this important post. There are attractive conditions of employment, including superannuation. The salary will depend on qualifications and experience, but will not be less than £2250 per annum, and could considerably exceed this figure for an outstanding candidate.

Applications should reach Headquarters Staff Manager (X.1577E) N.C.B., Hobart House, London, S.W.1, not later than 9th November, 1959.

E7750 A

SENIOR DESIGN ENGINEER, H.N.C. preferred, knowledge of hydraulics desirable and capable of designing, on own initiative, medium heavy machinery.—Apply Mr. Bedford, Chamberlain Industries, Ltd., Staffa Road, Leyton, E.10 (Tel.: LEY 3678). E7623 A

SENIOR ELECTRICAL FOREMAN.—Excellent opening offering wide scope for experienced Supervisor in Electrical Assembly Shop. Progressive outlook on production methods essential. Experience should include manufacture of small to medium electrical equipment. Good working conditions in modern progressive factory.—Apply, with full particulars, to J. Dewar, Personnel Manager, Lansing Bagnall, Ltd., Kingsclere Road, Basingstoke, Hants. E7770 A

SENIOR MANAGER.—A Steelworks in the Midlands, with expanding trade in section semis and rounds, wishes to engage a Senior Manager to supervise their finishing and despatch departments. Applicants should be technically qualified and have a working knowledge of modern industrial engineering techniques. Preference will be given to men with experience of roller straightening and ancillary processes. The post is a progressive one and there is a pension scheme and free life assurance scheme in operation. Applications, with full details of age, qualifications and experience.—BOX No. E7679, "The Engineer." A

STRUCTURAL ENGINEERS COMMERCIAL MANAGEMENT

Applications are invited from young ambitious men for appointment in Commercial Manager's office. The firm is in Manchester area and has expanding programme. A man, trained technically, preferably with commercial aptitude, and having confidence in ability to deal with varied duties normal to the trade covering initial sales/estimate through all activities to final invoice, would be given ample scope to develop. Salary and pension benefits attractive. Address full details, both personal and career to date, in strict confidence.—BOX No. E7724, "The Engineer." A

TECHNICAL SALES REPRESENTATIVE required by specialised Engineers in Group of international repute, for Sales of Industrial Filters in Northern Counties and Scotland. Salary, expenses and car allowance. Pension scheme. Previous experience essential.—Write, giving full details, to BOX 564, 6, Aldford Street, W.1. E7715 A

THE GENERAL ELECTRIC COMPANY, LIMITED ATOMIC ENERGY DIVISION

invites applications for a position in the

STRUCTURAL DEVELOPMENT LABORATORY AT ERITH

Applicants should hold a degree or H.N.C. and have an interest in structural test work.

Previous experience of this type of work is desirable, though not essential. It will be the duty of the successful candidate to design and order all necessary test components, carry out liaison and supervision of the drawing, construction and testing of rigs and to report on the test results.—Apply Personnel Manager (DWB/11), The General Electric Company, Ltd., Erith, Kent.

E7732 A

THE MOND NICKEL COMPANY LIMITED

requires a FOUNDRY METALLURGIST with practical experience of iron and steel-founding, for development work on production and use of alloy and S.G. irons. Experience in liaison with engineering users would also be an advantage. Pension and assurance schemes are in operation and, in appropriate cases, assistance can be given with housing.

Apply, giving full particulars of qualifications, experience, age, salary required, &c., to the Secretary, Development and Research Department, The Mond Nickel Company, Ltd., Thames House, Millbank, London, S.W.1. Mark envelope "Confidential Dev. 30." E7701 A

VACANCY FOR FULLY QUALIFIED ENGINEER to take complete charge of varied type contracts in up to £10,000 medium general engineering class ; applicant must have a lively and versatile personality, and be prepared to cover detailed design work. Appointment is subject to pension. Applications must give details of qualifications, experience and salary requirements. Works located in South London.—BOX No. E2608, "The Engineer." A

WEST MIDLANDS GAS BOARD INDUSTRIAL GAS REPRESENTATIVES

With the increase in the development and utilisation of gas for Industrial purposes, further appointments will be made in the Midlands to meet the demand.

The work will involve investigation and submission of schemes for the use of gas for furnace heating and other industrial purposes.

Applications are invited from candidates with an appropriate University Degree, or similar qualification. Experience of Industrial Gas is not essential as adequate training will be given.

The salary during the training period will be in accordance with Grade A.P.T.7 (£733–£813 per annum) of the National Salary Scales for Gas Staffs, and subject to satisfactory completion of the training, appointment to a permanent post on a higher grade will be made. The appointments are pensionable and subject to medical examination.

Applications, stating age, education, qualifications and experience, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, Augustus Road, Edgbaston, Birmingham, 15.

J. SWAN,
Secretary to the Board.

E7709 A

WANTED, young competent ENGINEER with experience of plant layout. Good prospects for suitable applicant. Apply stating age, experience and qualifications which must include Higher National Certificate or equivalent.—BOX No. E2571 ," The Engineer." A

WORKS MANAGER for fabricating boilers, pressure vessels and heat exchangers. Accustomed to Lloyd's Class I rules, hand and automatic welding. Sound administrator and strict controller of production costs under piecework system. Dudley/Wolverhampton area. Apply, stating age and experience. Applications will be treated in the strictest confidence. —BOX No. E2599, "The Engineer." A

WORK STUDY ENGINEER

A fully-qualified and experienced WORK STUDY ENGINEER is required to head a rapidly expanding Work Study Department which will be concerned with comprehensive method studies on machine utilisation and the development and operation of incentive schemes. The factory is in the Manchester area and workers employed exceed 1000.

Applicants should hold a University Degree or should be Corporate Members of the Institution of Mechanical Engineers, or the Institution of Electrical Engineers, or the Institution of Production Engineers, and should be at least 30 years of age.

The successful applicant would be given an intensive and comprehensive course of training before assuming full responsibility, and would be required to join the Company's Pension Scheme.

The salary will be in the range of £1200/£1500 per annum, according to qualifications and experience.

Applications to BOX No. E2603, "The Engineer." A

WANTED, FIRST-CLASS SENIOR DESIGN DRAUGHTSMAN for firm of General Engineers in Bristol. Good knowledge of general engineering, with particular reference to pressure vessels and stainless steel fabrication. This will be a well-paid position for the top-class man.—BOX No. E164, "The Engineer." A

WATER TREATMENT DRAUGHTSMEN

DRAUGHTSMEN, senior or junior, with experience in water treatment are required by a rapidly expanding firm who can offer permanent pensionable positions, with a profit sharing bonus which last year amounted to 22 per cent. of salary.—Apply, in writing to William Boby and Co., Rickmansworth, Hertfordshire.

E7644 A

WORKSHOP MANAGER required in Kuwait, Persian Gulf. Applicants should have sound engineering background and be capable of taking charge of workshop specialising in repair and overhaul of petrol and diesel engines up to, say, 350 B.H.P. Free air passages, furnished accommodation, light and water.—Write, Personnel Officer, Mitchell Cotts Group, Ltd., Cotts House, Camomile Street, London, E.C.3. E7769 A

SENIOR DRAUGHTSMAN

(Plant Engineers)

Applications are invited for this appointment, responsible to the Group Chief Engineer, at the Headquarters in Central Manchester of a large group of Companies in a processing industry.

The work is very varied, ranging from the design of special purpose process machinery to installation and repair of works services and building fabric. It also provides the opportunity to use initiative and ideas under minimum supervision, with excellent prospects for the future. Starting salary £900 p.a.

Required qualifications are : age 28–35 approx., H.N.C. (Mech.) ; at least 5 years in a process industry in Plant Engineers Department, or with manufacturers of process machinery of a mechanical type.

Hours of work : 9 a.m.–5 p.m. ; five-day week with alternate Saturdays ; canteen ; pension scheme.

Please write briefly in first instance, quoting Ref. No. 258, to :

ASHLEY ASSOCIATES LTD.
PETER HOUSE, MANCHESTER 1
retained to advise on this appointment

The strictest confidence will be observed and no details of candidates will be passed to clients without candidates' permission.

E7742 A

SITUATIONS VACANT

SENIOR DESIGN ENGINEERS AND DRAUGHTSMEN

Applications are invited from Design Engineers and Draughtsmen with general experience of Steel and Iron Works practice or steel structures, mechanical handling and foundry plant. These are important, progressive posts in a large and expanding organisation and will carry a generous salary. The work is varied and interesting and offers first-class opportunities for suitable men.

A five-day week is operating, holidays are generous, and there is a contributory pension scheme with free life assurance.

The Works are situated near to a good residential area and a number of excellent schools are available in the district. Assistance with housing will be given if required.

Applications, which will be treated in confidence, should be addressed to the Staffing Officer and should give age and details of technical qualifications and experience.

THE STANTON IRONWORKS COMPANY, LIMITED, P.O. BOX No. 3, NEAR NOTTINGHAM

E7745 A

SITUATIONS VACANT

QUALIFIED ENGINEER

required to take charge of die design section and Toolroom for die manufacture.

Knowledge of extrusion and Tool making essential, and of Aluminium and its alloys an advantage.

Permanent position and superannuation for suitable applicant.

Details of experience and salary expected to :

The Manager,
British Aluminium Co., Ltd.,
Bank Quay,
Warrington,
Lancs.

E2610 A

SITUATIONS VACANT

STRUCTURAL ENGINEERS

COURTAULDS have vacancies for STRUCTURAL ENGINEERS at its Engineering Headquarters in Coventry. Applicants should have good theoretical and practical knowledge, and be capable of designing and detailing steel or concrete structures.

Candidates should write for a detailed form of application to the Director of Personnel, Courtaulds, Ltd., 16, St. Martin's-le-Grand, London, E.C.1, quoting reference number B.57.

E7755 A

ENGINEERING DESIGN IN THE RUBBER MANUFACTURING INDUSTRY?

. . . a pertinent question, but one which is easily answered. Never before have there been greater opportunities for DESIGNER DRAUGHTSMEN than exist to-day at Fort Dunlop—the largest factory in the DUNLOP GROUP. Modern manufacturing techniques call for qualified men with imagination and drive. These openings are as follows :—

(*a*) **MECHANICAL :** design draughtsmen with National Certificates and appropriate experience are required for projects connected with the continual modernisation and expansion of the Fort Dunlop tyre factory and ancillary equipment. Preference will be given to those with experience of special-purpose machine design or mechanical handling and plant layout. These openings have arisen due to the transfer of existing staff to overseas factory projects.

(*b*) **ELECTRICAL :** there is a vacancy for an electrical draughtsman to carry out design work in connection with electrical equipment for new installations at Fort Dunlop. The work will be varied and interesting and will involve the preparation of wiring diagrams for automatic machines, using modern methods of control. A knowledge of industrial electronics will be advantageous.

Applicants are invited for any of the above posts, all of which are pensionable to men under 44 years of age at the time of engagement. Those interested should apply in confidence, giving brief details and commencing salary expected, to :

STAFF OFFICER, EMPLOYMENT DEPARTMENT (REFERENCE E)
FORT DUNLOP, ERDINGTON, BIRMINGHAM, 24

E7727 A

INDIA

GENERAL MANAGER

A well-established manufacturing and marketing organisation with world-wide interests in the air-conditioning and refrigeration equipment field requires a DIVISIONAL GENERAL MANAGER for the whole of India.

Age 38–50. Successful applicant must be first-class administrator and organiser with practical experience in budgetary and cost control and be an outstanding executive in trading operations. Technical engineering qualifications, particularly in refrigeration, essential, with membership in appropriate senior engineering institutions. University degree perferable.

Total annual income with special allowances amounts to several thousands of pounds. Free passages for family and subsidised living quarters.

Apply in GUARANTEED STRICTEST CONFIDENCE, stating date of birth, details of education, names of firms and positions held with dates, and initial and final salaries, and contact telephone number, quoting reference J.N.3833.

Applicants who are short-listed can expect acknowledgement within ten days of receipt of application.

Dr. P. S. de Q. Cabot,
P. S. CABOT & COMPANY,
37–41, Bedford Row,
London, W.C.1.

E7752 A

PERMALI LIMITED

GENERAL WORKS MANAGER

A first-class man is required for this senior appointment, shortly vacant due to retirement. The Company's products include the manufacture of a range of laminated plastics for electrical and general engineering applications, usually supplied as fully machined component parts, but the Company has developed interests in other fields.

Engineering background essential, together with wide knowledge of modern approach to production methods, and works administration.

Responsibilities include control of 600 staff and workers, and the position carries commensurate salary, and pension.

Reply in confidence, giving full particulars of age, qualifications, experience and present position, to :—

The Secretary,
Permali Limited,
Bristol Road,
Gloucester.

7728 A

SHEEPBRIDGE ENGINEERING LIMITED CHESTERFIELD

Due to continued expansion, the following vacancies have arisen :

PROJECT DESIGNERS, SENIOR PRODUCTION DESIGNERS, CONTRACTS ENGINEERS, TRAINEE SALESMEN

PROJECT DESIGNERS are required for the Mechanical Handling Division, experienced in preparation of project drawings, specifications and estimates for Bulk Material Handling, covering the Mining, Quarrying, Iron and Steel, Oil and Chemical Industries.

SENIOR PRODUCTION DESIGNERS are required for the detailed design of Handling Plants, working from project drawings and specifications. They should be capable of handling complete contracts, including structural design. Crane experience would be advantageous.

CONTRACTS ENGINEER. Senior man having experience of contract control from all aspects, viz. : Projects, Tendering, Control of Contract, Site Activities, and Commercial Procedure. Required for contracts in the Mining Industry and similar mineral treatment plant. Must have Drawing Office, Project and Production experience, and some knowledge of Sales Procedure, and negotiations.

TRAINEE SALESMEN. Suitable man needed for future extension of our Sales Service in the Southern Area. The selected person will receive an initial training for nine months in our Project Department on projects for Mining, Quarrying, Iron and Steel and Oil Industries, after which he would take up Sales Representation in the South of England.
Write, giving details of experience, qualifications, age, salary required, and stating vacancy in which primarily interested, to Personnel Manager.

E7725 A

Classified Advts. continued on page 150

SITUATIONS VACANT

SENIOR PRODUCTION ENGINEERING STAFF

Owing to continued expansion, a Machining Division of a large group of companies dealing with a wide range of precision machining and high quality press work has vacancies for :

Estimating Engineers with a sound engineering background and a familiarity with modern machining techniques. Candidates will be required to prepare estimates from information covering a wide range of machine activity. H.N.C. desirable but not essential.

Planning Engineers. Applicants should have practical engineering training and a sound technical knowledge of tool design and planning covering press work and machining. The selected candidates will be capable of putting new projects into production on a sound basis.

Press Tool Designers with considerable experience of economic tool design for products associated with the light electro-mechanical field. A knowledge of progression and deep drawing tools desirable.

Time Study Engineers with previous experience of piecework systems and bonus schemes applicable to light precision machining and sub-assemblies.

These positions offer long-term employment together with generous and progressive salaries. London area. Interviews will take place during normal business hours or, alternatively, on a Saturday morning if preferred.

Please reply, giving details of age, qualifications and experience,—BOX No. E7730, "The Engineer."

A

SITUATIONS VACANT

ENGLISH ELECTRIC
Preston, Lancs.
wish to appoint a

DIESEL ENGINEER

to undertake functional design investigations from commissioning and operating reports connected with medium speed traction and industrial diesel engines up to 2500 b.h.p.

A keen graduate Engineer who has acquired his knowledge in a development department and now wishes to apply his experience to Design would be preferred. On occasions the duties will involve field investigations. Salary will be commensurate with training and experience.

Please write giving full details to Dept. C.P.S., Marconi House, 336–7, Strand, London, W.C.2, quoting reference E1004A.

E7705 A

SENIOR DRAUGHTSMEN

experienced in bulk mechanical handling or foundry work. Superannuation Scheme. Five-day week. Apply to MARCO CONVEYOR & ENGINEERING COMPANY Ltd., Lynn Road, Leytonstone, London, E.11. LEY 2254.

E7749 A

SITUATIONS VACANT

APC

ATOMIC POWER CONSTRUCTIONS LIMITED

TECHNICAL ENGINEERS

for

REACTOR DESIGN

Senior and junior vacancies exist in a technical team forming part of the Reactor Design Department of the above Company, whose current work includes the Nuclear Power Station now being built at Trawsfynydd, and other reactor projects. The technical team is responsible for structural and thermal problems arising in design and works in close association with the Company's Research and Development Laboratories.

Applicants should have a degree in mechanical or chemical engineering and be interested in problems demanding original thought. Nuclear experience not essential, but experience in power station or similar work would be an advantage.

Applications, giving full details of qualifications and experience, should be addressed to :—

The Personnel Officer (Ref. 91/E),
Atomic Power Constructions Limited,
28, Theobalds Road, W.C.1.

E7702 A

WHESSOE

WHESSOE LIMITED OF DARLINGTON REQUIRE ADDITIONAL SALES ENGINEERS

These appointments are for the purpose of extending the company's sales, at home and abroad, of WHESSOE Capital Plant and Equipment in the

OIL, GAS, CHEMICAL & ALLIED INDUSTRIES

Applications are invited from those who in addition to having an engineering background or engineering qualifications, have also a proved record of sales experience: enthusiasm for, and knowledge of selling is a pre-requisite.

The company operates a pension and life insurance scheme.

Letters of application (marked Confidential), giving full details of career to date, age and salary required should be sent to—

Sales Manager **WHESSOE LTD. 25 VICTORIA ST. LONDON S.W.1**

E7734 A

Applications are invited for posts as PROFESSIONAL ENGINEERS and PHYSICISTS, as under.

HONOURS DEGREE PHYSICIST

as Senior Reactor Physicist for a prototype naval Reactor. Work will include commissioning tests. Previous experience in the design of P.W.R. and a knowledge of zero energy facilities will be an advantage.

CHARTERED ELECTRICAL ENGINEER

to be responsible for the operation of all electrical machinery associated with a Prototype Naval Reactor. A good theoretical knowledge combined with practical experience is required, covering all aspects of a.c. and d.c. Power Distribution for Propulsion Machinery. Arrangements will be made for the successful candidate to receive adequate specialised training.

HONOURS DEGREE PHYSICIST OR MATHEMATICIAN

as member of a research team carrying out technical and design work on nuclear propelled vessels. Prior training in reactor physics will be given if necessary.

PROFESSIONAL ENGINEER

preferably an Honours Graduate for the above team. M.O.T. ticket will be of considerable advantage in this position.

All the above vacancies offer exceptional opportunities to ambitious and properly qualified men. Applications giving full details should be addressed to :—

THE MANAGER, MARINE PROPULSION, RESEARCH AND DEVELOPMENT,
VICKERS-ARMSTRONGS (ENGINEERS) LIMITED,
NAVAL CONSTRUCTION WORKS, BARROW-IN-FURNESS, LANCASHIRE

E7726 A

ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET

DESIGN ENGINEER

A PROFESSIONAL Engineer is required to lead a section concerned with the design and technical aspects of research reactors and their utilisation.

Duties will include making calculations relating to heat transfer, fluid flow, shielding, nuclear heating and reactor kinetics, and advising on technical aspects of experimental design and reactor safety.

Applicants should be corporate members of a senior engineering institution. A wide knowledge of engineering materials and manufacturing techniques is essential. An Engineering Degree would be an advantage.

Salary : £1855–£2155 p.a.

Housing and Superannuation schemes.

Send POSTCARD for application form and details to Personnel Branch (W.179/25), U.K.A.E.A., A.E.E., Winfrith, Dorchester, Dorset.

Closing date, 21st November, 1959.

E7706 A

SENIOR DESIGNERS
SENIOR PLANT LAYOUT DRAUGHTSMEN
DESIGNER DRAUGHTSMEN

Unique opportunities occur on new project team for development in the seamless steel tube industry.

Minimum qualifications H.N.C.

Apply, stating qualifications and experience, to the Personnel Manager.

TUBES LIMITED, KIRBY MUXLOE,
Nr. LEICESTER

E7711 A

SITUATIONS VACANT

EXPERIENCED AND ENERGETIC

CIVIL ENGINEER

REQUIRED FOR ABROAD

PREFERABLY with experience of plant comprising heavy machinery. SALARY according to experience and will be free of Income Tax. APPLICATIONS will be treated strictly in confidence and should be sent, with usual particulars, to BOX No. E7723, "The Engineer."

A

ASQUITH MACHINE TOOL CORPORATION LIMITED

ASSISTANT TO DIRECTOR

Applications are invited for the above vacancy on the staff of William Asquith, Limited, Halifax, manufacturers of High Grade Heavy and Medium Machine Tools.

The successful applicant will be responsible to, and be required to assist, the Group Director in charge of manufacturing with the general administration of production.

Candidates should have a professional qualification in Mechanical Engineering and an extensive experience of Modern Machine Tools and precision manufacturing methods.

Preferred age 35-40.

The position offers excellent prospects with substantial initial salary and membership of the Company's Non-Contributory Pension and Life Assurance Scheme.

Please write in confidence, giving details of age, experience and qualifications to the Group Technical Director, ASQUITH MACHINE TOOL CORPORATION, LIMITED, HIGHROAD WELL, HALIFAX, YORKSHIRE.

E2602 A

SENIOR CORROSION METALLURGIST

is required by

ENGLISH ELECTRIC, RUGBY

The appointment will entail taking charge of corrosion investigations mainly concerned with the design, production and operation of modern Power Station equipment.

Applicant should be 26 to 30 years of age, possess graduate qualifications, and have actual experience of corrosion, either by research work or by employment in industry. Although experience of Power Station equipment would be ideal, mechanical plant knowledge could be accepted. Write, giving full details, &c., to Dept. C.P.S., Marconi House, 336/7, Strand, London, W.C.2, quoting reference E1114A.

E7703 A

ASQUITH MACHINE TOOL CORPORATION LIMITED

PROJECT ENGINEER

A Project Engineer is to be appointed who will be responsible to the Group Director in charge of manufacturing for the introduction into production of new types of High Grade Heavy and Medium Machine Tools.

The appointment will be on the staff of William Asquith, Ltd., Halifax, and applicants should be between 30 and 40 years of age.

Candidates should be educated to at least H.N.C. standard and have extensive technical and practical experience of Machine Tool Production.

An attractive salary will be paid for this appointment, which will also qualify for membership of the Company's Non-Contributory Pension and Life Assurance Scheme.

Applications in confidence, stating age, experience and qualifications to the Group Technical Director, ASQUITH MACHINE TOOL CORPORATION, LTD., HIGHROAD WELL, HALIFAX, YORKSHIRE.

E2601 A

SITUATIONS VACANT

DIESEL MAINTENANCE INSTRUCTOR WANTED

British Railways, Eastern Region, invite applications for the position of Senior Instructor for the Motive Power School for Diesel Maintenance located at Ilford, Essex.

Applicants must have served an apprenticeship, preferably in a diesel locomotive works, and have had experience of servicing and maintenance of diesel-electric locomotives. Ordinary National Certificate or equivalent essential.

The salary range offered is £914, rising to £985 (max.) per annum.

Certain rail travel facilities, compulsory Superannuation Scheme.

Apply in writing to:

Line Traffic Manager,
British Railways,
Eastern Region,
Liverpool Street Station,
London, E.C.2,

quoting reference E.S.2/18/G.

E7717 A

SITUATIONS WANTED

METALLURGIST (42), graduate, considerable experience in engineering industry, laboratory, production and administration, ferrous and non-ferrous foundries, heat-treatment, deep drawing and pressing, metal finishing, &c., desires new appointment.—BOX No. E2607, "The Engineer." B

ENGINEER, M.I.P.E. 30 years' experience, Production Engineer, Production Manager, Works Manager. Offers services as such; will consider alternatives. Planning and starting new factory, reorganising investigations, directors or managers' assistant, personnel management, &c. Greater London, Kent, Sussex areas.—BOX No. E2612, "The Engineer." B

FOR HIRE

BELLMANS MASTS FOR HIRE, to lift from 1 to 20 tons, 30ft. to 150ft. Blocks and tackle. Hand-operated winches. From £1 per day.—BELLMAN'S (Phone: SLOane 5259), Hobart House, Grosvenor Place, S.W.1. E103 K

MOBILE LIFTING SERVICES.—Lump sum or Hire Rate Quoted for any Lifting Work by Lorry-Mounted or Crawler Cranes, any size, any area.—TARSLAG, LTD., Rotherham 3235. E168 K

PATENTS

THE PROPRIETORS of British Patents Nos. 761,703 for "VALVE ASSEMBLY," and 762,420 for "PRECISION CONTROL SYSTEM FOR PRESS BRAKES OR THE LIKE," desire to enter into negotiations with a firm or firms for the sale of the patents, or for the grant of licences thereunder. —Further particulars may be obtained from Marks and Clerk, 57 and 58, Lincoln Inn Fields, London, W.C.2. E7720 H

BUSINESSES and PREMISES

TO LET, SELF-CONTAINED OFFICE SUITE, Two rooms, Westminster, near St. James's Park Underground Station. Good Lease and Address.—Apply, Owners, 23, Chandos Court, Caxton Street, S.W.1. E2587 L

BUSINESS OPPORTUNITIES

REMPLOY SPONSORSHIP SCHEME.—Send for details which show an attractive proposition to manufacturers.—Write to the Managing Director, Remploy, Ltd., 25–28, Buckingham Gate, S.W.1, or telephone VICtoria 6621 (12 lines). E155 O

ADVERTISER, PRIVATE INVESTOR desires to purchase whole or part interest in concern under progressive management making annual net profit of £15/50,000.—BOX No. E163, "The Engineer." O

TO ENGINEERING GROUPS.—Ultra Modern Foundry producing HIGH-GRADE GREY IRON CASTINGS, capacity 200 tons weekly. Would consider amalgamation and/or co-operation. Asset value of freeholds and plant approximately £150,000/£200,000.—BOX No. E165, "The Engineer." O

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process; sample castings treated; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone: Knottingley 2743/4). E116 MW

CONTROL CUBICLES, SWITCHGEAR CABINETS OF SUPERB FINISH made to your specifications. Competitive prices and reasonable delivery.—KERSHAW, HUGHES AND PARTNERS, LTD., 21, FARGATE, SHEFFIELD, 1. E2574 MW

MACHINERY Etc. WANTED

ONE 400 kW 500 kVA DIESEL ALTERNATOR SET, 400/3/50 cycles 4-wire supply, such as Petters or Blackstone.—BOX No. E2595, "The Engineer." F

FOR SALE

600

CONDENSERS AND HEAT EXCHANGERS

BELLISS AND MORCOM Surface Condenser, 8ft. 6in. long by 3ft. 6in. diameter, designed for 8400 lb. exhaust steam per hour, maintaining 26in. vacuum when supplied with 29,000 gallons of cooling water per hour at 75 deg. Fah., complete with water circulating and condensate pump.

WORTHINGTON SIMPSON 7500 lb steam per hour at a vacuum of 26in. when supplied with 30 g.p.m. of circulating water at 80 deg. Fah., complete with combined a.c. motor driven water circulating and condensate extraction pump.

DAVEY PAXMAN Surface Condenser, 10,000 lb. steam per hour at 26in. vacuum when supplied with 500 gallons of cooling water per minute, at a temperature of 70 deg. Fah., complete with water circulating and extraction pump.

BELLISS AND MORCOM Condenser, 17,000 lb. steam per hour at 25in. vacuum when supplied with 43,000 gallons of cooling water per hour at a temperature of 80 deg. Fah., complete with extraction pump and air ejector.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12
(Phone: SHEpherds Bush 2070); and
STANNINGLEY, Nr. LEEDS
(Phone: Pudsey 2241.) E204 G

FRED WATKINS (ENGINEERING) LTD.

Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton, ditto, 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 5ft. Kilns or Dryers, with Crofts Reduction Gear and 27 h.p. motor.
Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motor.
Available at low prices ex present sites to save cost of bringing into stock.

FRED WATKINS (ENGINEERING), LTD., COLEFORD, GLOS. E151 G

FOR SALE

NEWALL 10in. by 48in. Type LA
HEAVY DUTY HYDRAULIC
CYLINDRICAL GRINDING MACHINES

Main motor 20 h.p., takes grinding wheel 36in. diameter by 10in. face. 1951 machines in first-class condition.

F. J. EDWARDS LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
EUSton 4681 and 3771.

E7647 G

FOSTER YATES AND THOM DOUBLE PASS ECONOMIC BOILER, 8ft. 6in. dia. by 14ft. long over tube plates. Manufactured 1956. Evaporation 8500 lb. per hour, working pressure 150 lb. Complete with Proctor Mechanical Stoker and motor-driven induced draught fan.

Also:

DANIEL ADAMSON VERTICAL CROSS-TUBE BOILER, 4ft. dia. by 9ft. high. Manufactured 1952. Evaporation 800 lb. per hour, working pressure 120 lb.

All as new and only used for a period of approximately one year, can be viewed by appointment on site in Essex. Write.—BOX No. E7605, "The Engineer." G

JACKMAN SHOTBLAST PLANT, comprising Shotblast Room 15ft. long by 9ft. by 9ft., complete with Scroll Conveyor and Elevator, Rotary Sieve, Abrasive Cleaner and Shotblast Unit, together with Screen Filter and Fan. Manufactured 1956. As new and used for a period of approximately one year only. Can be viewed by appointment on site in Essex.—Write.—BOX No. E7607, "The Engineer." G

600

DIESEL ENGINE DRIVEN
ALTERNATOR SETS

500kW continuous 400V., 3-phase, 50 cycles, 4-wire BELLISS AND MORCOM/LANCASHIRE DYNAMO COMPANY Diesel Engine Driven Alternator Set, direct coupled at 375 r.p.m. and comprising 7-cylinder vertical engine complete with ancillaries and starting equipment. Direct coupled to alternator with switchgear.

Six 330kVA, 400/440V, 3-phase, 50 cycles, 4-wire self-contained RUSTON PAXMAN type 12RPH2/B.T.H. Diesel Engine Driven Alternator Sets, radiator fan cooled. Each on bedplate and direct coupled at 1000 r.p.m.; electric starting; standard ancillaries and switchgear.

Two 270kVA, 400/440V, 3-phase, 50 cycles, 4-wire MIRRLEES TL6/BRUSH Diesel Engine Driven Alternator Sets, direct coupled at 600 r.p.m.; standard ancillaries, starting equipment and switchgear. Reconditioned ready for work.

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234kVA, 400/440V, 3-phase, 50 cycles, MIRRLEES Type UA8/METROPOLITAN-VICKERS Diesel Engine Driven Alternator Set, mounted on baseplate and direct coupled at 500 r.p.m.; standard ancillaries, starting equipment and switchgear. Little used.

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Classified Advts. continued on page 152

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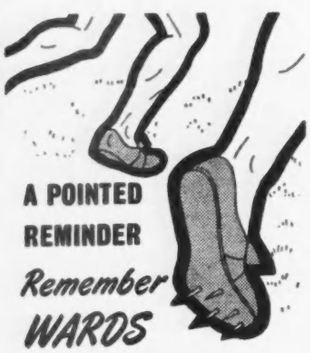

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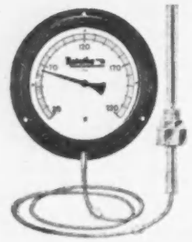

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Monitors the blow-down. Continuously Gives Warning—Visual and Audible—of Maximum and Minimum Density. Has Warning Points infinitely adjustable within the permitted range.

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RHODES No. 20 Size Inclinable Power Press, fitted with Udal automatic press guards, pressure exerted approximately 20 tons, stroke 2in., centre to back 8in., size of bed 22in. by 40in., hole in bed 10½in. by 10½in., weight approximately 20 cwt.

WESTON Model 400/100 Double-Sided Friction Screw Press of welded steel plate construction, arranged motor drive for 400/3/50, pressure exerted approximately 120 tons, maximum stroke 11in., diameter of screw with four starts 6½in., size of bed 21⅛in. by 18in., weight approximately 5 tons.

NEW BESCO Motorised Geared Angle Bending Machine, Undercrank type, arranged motor drive for 400/3/50, complete with top and bottom 90 deg. vee forming tools, capacity, mild steel, 5ft. by 14 S.W.G., length of tools 61⅛in., stroke of top beam 2½in., maximum daylight, bed to top beam, 8½in., number of strokes per minute 21, weight approximately 52 cwt.

SCHULER Model AKU Power Operated Geared Guillotine, Undercrank type, balanced drive, with automatic sheet hold-down and all gauges, motorised for 400/440/3/50, maximum working length 101¼in., weight approx. 45 cwt.

QUICKWORK No. 32L Motorised Rotary Shearing Machine, with circle cutting attachment, arranged motor drive for 400/440/3/50, capacity, mild steel, 14 S.W.G., cuts circles from 6in. to 60in. diameter, hand feed control lever enables operator to cut intricate shapes by hand, weight approximately 18 cwt.

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2000-ton Down-stroke FORGING PRESS, 5ft. stroke ; bed 8ft. 6in. by 8ft. ; daylight 11ft.
1000-ton Down-stroke FORGING PRESS by Wellman, bed 7ft. by 6ft. ; daylight 9ft.
475-ton FLANGING PRESS by Hugh Smith, table 10ft. dia., 4 vice rams.

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ELECTRICALLY DRIVEN COMPRESSOR SETS FOR USE ON 400/440 VOLTS 3-PHASE 50 CYCLES SUPPLY

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PRECIMAX HYDRAULIC VERTICAL SPINDLE SURFACE GRINDER. Cap. 48in. by 15in. Segmental wheel 18in. diameter. With magnetic chuck 15in. by 48in.—H. BELL (MACHINE TOOLS), LTD., Walter Street, Leeds, 4. Tel.: 63-7398. E7735 G

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C.f.m.	Make	P.s.i.	Type	H.p.
600	Broomwade	100	EH.255	135
494	Broomwade	100	EH.251	120
330	Broomwade	100	EH.241	75
300	Holman	100	TH36S	70
270	Broomwade	100	E.240	55
215	C.P.T.	100	PB–4–210	50
200	Broomwade	100	D.23	45
150	Broomwade	100	D.22A	35

With or without electrical equipment.

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750kW, 400V, 3-phase, 50 cycles, back pressure type Steam Turbo Alternator Set by METROPOLITAN-VICKERS ; steam pressure 485 p.s.i.g., 550 deg. Fah., back pressures between 25 and 60 p.s.i.g. Complete with BABCOCK AND WILCOX Water Tube type CT. Boiler, evaporation 20,000 lb/hour maximum, heating surface 3805 square feet, 500/525 lb. w.p. All the foregoing forms a complete installation, the boiler grate being suitable for fuel of low calorific value, such as sugar cane, &c.

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E2609 G

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FIXED TOWER CRANES by Sir Wm. Arrol. Capacity, 5½ tons at 110ft. radius, 8 tons at 55ft. radius. Height of cantilever 122ft. 9in. Electrics 440/3/50 cy. For immediate sale at attractive prices. Apply.—BOX No. E7707, "The Engineer." G

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OVERHEAD CRANES. — 30/5-ton Adamson 42ft. 3in. span, 400/3/50 ; 20/6-ton Vaughan, 42ft. 3in. span, cab type (6) ; 20-ton King, 42ft. 3in. span, 400/3/50 ; 15-ton Morris, 35ft. span, hand-operated ; 10-ton Morris, 45ft. span, 36ft. lift ; 10-ton Morris "Goliath," 40ft. span, 400/3/50 ; 10-ton Vaughan, 23ft. 6in. span, 400/3/50 ; 10-ton Vaughan, 21ft. span, 44ft. lift, 7½ tons ; Wharton, 25ft. span, 400/3/50 ; 5-ton Henderson, 24ft. 7in. span, 1946 ; 5-ton Morris, 58ft. span, hand-operated ; 5-ton Royce, 2-motor crab, 440/3/50 ; 5-ton King, 29ft. 3in. span, power hoist, hand travel ; 5-ton Morris, 28ft. 6in. span, power hoist, hand travel ; 4-ton Morris, 19ft. span, 220V, d.c. (3) ; 3-ton Adamson, 48ft. span, 400/3/50 ; 2-ton Adamson, 34ft. span, 400/3/50 (2) ; 2-ton Morris, 18ft. span ; 2-ton Vaughan, 27ft. 6in. span, 2-motor ; majority of the above are unused.
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SALES BY AUCTION

		Main Location	*Auctioneer*
November 3	**Miscellaneous stores,** including textiles, etc.	Command Ordnance Sub - Depot, **Devizes.** (Sale at Corn Exchange, Devizes.)	**FARRANT, WIGHTMAN & PINNIGAR** (Dept. L), 2, Newport Street, Swindon, Wilts. (Tel.: 5151/2.)
November 12-13	**Miscellaneous stores,** including :—	Central Ordnance Depot, **Didcot, Berks.**	**SIMMONS & SONS** (Dept. L), 12, Station Road, Reading, Berks. (Tel.: 54025.)
	Hammers, spanners ; twist drills ; screwdrivers ; files ; oilstones ; plumbers, carpenters, blacksmith and engineering tools and equipment ; canvas covers ; tentage ; sacks ; thread ; cases ; cartons ; bins ; gravity rollers ; hoisting and lifting equipment ; laminated metal foil ; fire fighting equipment ; soap ; kitchen equipment ; paint ; furniture ; racking, etc.		
November 17	**Miscellaneous stores.**	M.O.A. Storage Depot, **Ruddington, Notts.**	**WALKER, WALTON & HANSON** (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
November 25	**Machine tools and miscellaneous stores.**	Technical Stores Depot, **Old Dalby, Leics.** (Sale at Melton Mowbray).	**SHOULER & SON** (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 3081.)
December 3	**Miscellaneous stores.**	M.O.A. Storage Depot, **Rotherwas, Hereford.**	**RUSSELL, BALDWIN & BRIGHT, LTD.** (Dept. L), 20, King Street, Hereford. (Tel.: 4366.)
December 8	**Machine tools and miscellaneous stores.**	M.O.A Storage Depot, **Byley, Nr. Middlewitch, Cheshire.** (Sale at Cheetham Town Hall, Manchester, 8.)	**J. H. NORRIS & SON** (Dept. L), 9, Albert Square, Manchester, 2. (Tel.: Blackfriars 8373.)
December 15	**Miscellaneous stores.**	General Stores Sub-Depot, **Longtown, Nr. Carlisle.** (Sale at County Hall, Carlisle.)	**HARRISON & HETHERINGTON** (Dept. L), Botchergate, Carlisle. (Tel.: 26292.)

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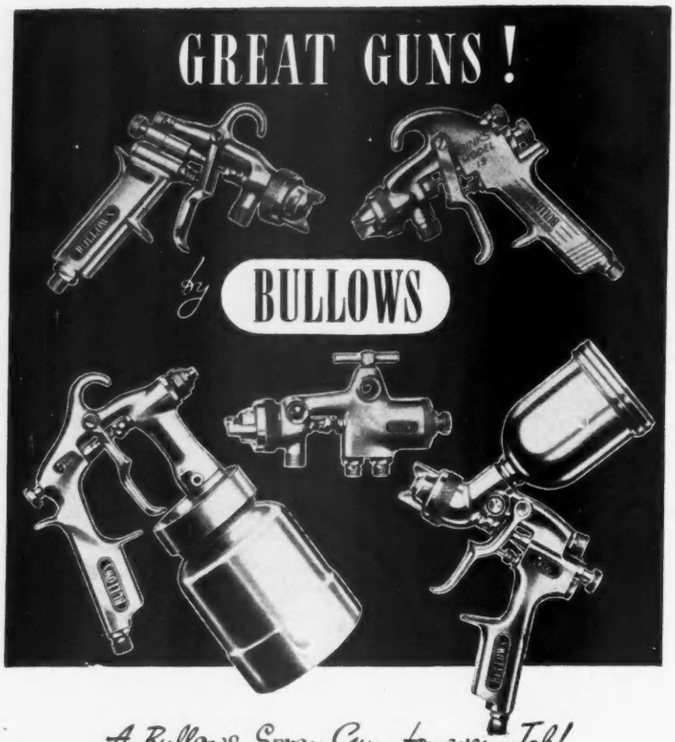

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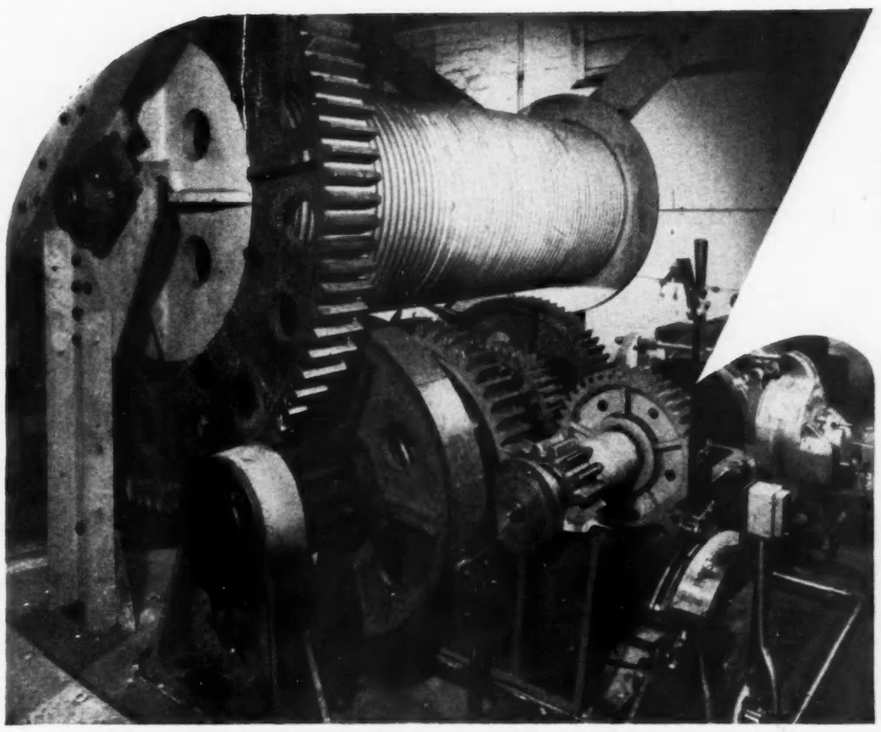

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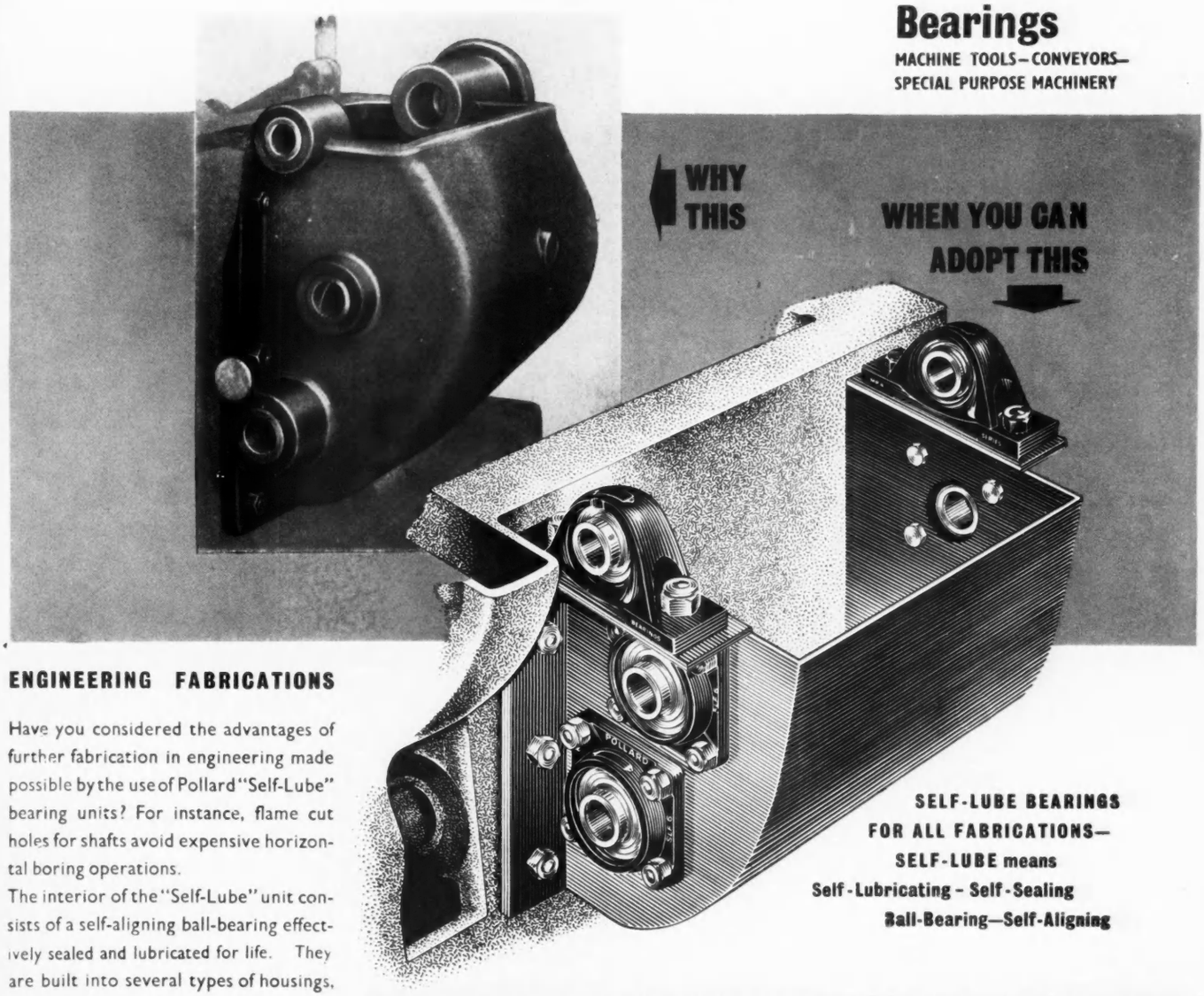

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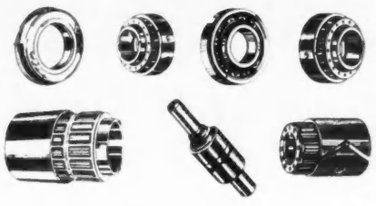

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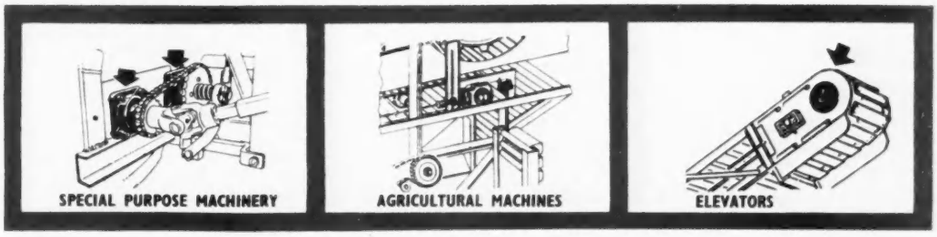

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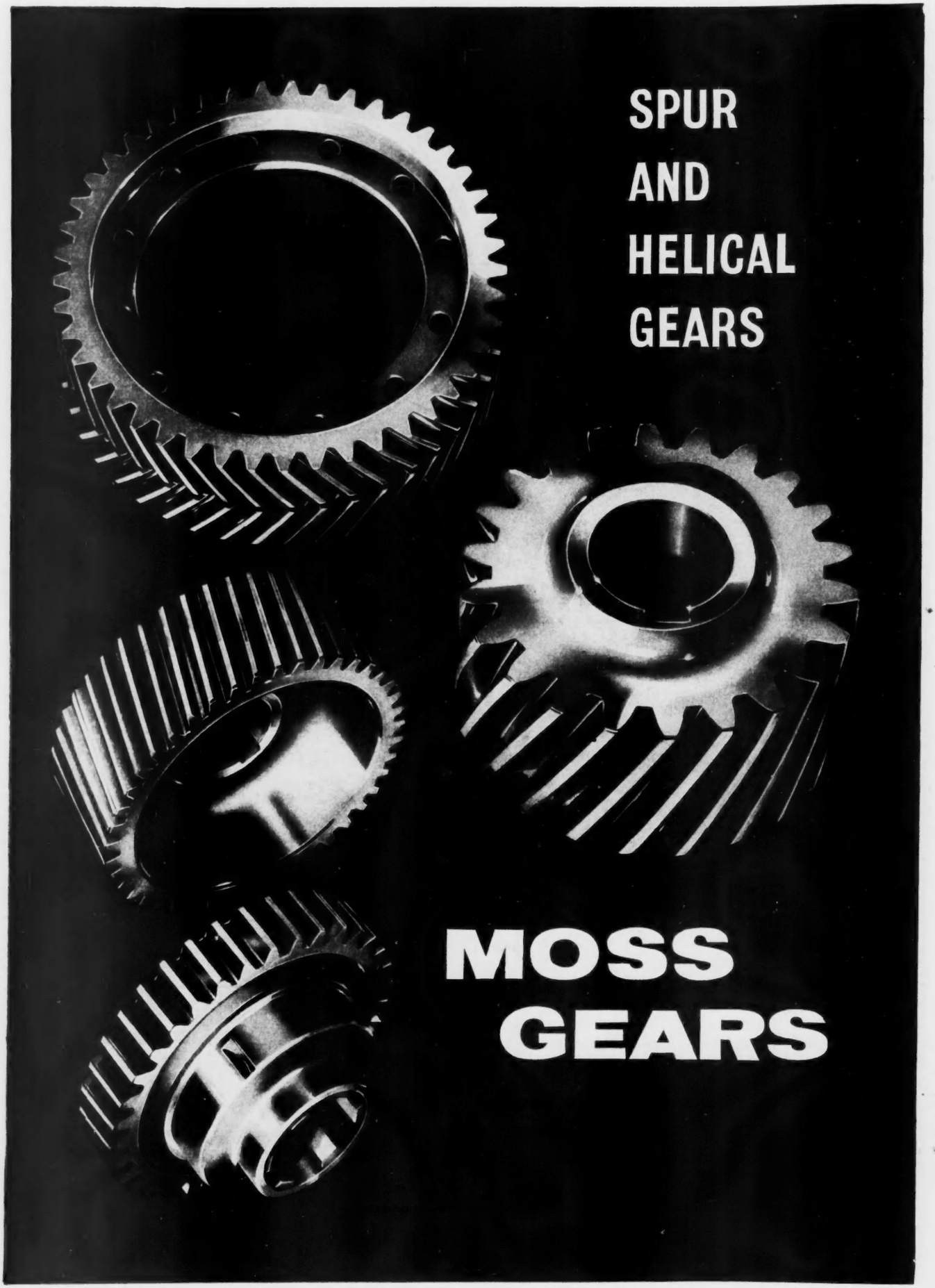

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